

Before the
Federal Communications Commission
Washington, D.C. 20554

FCC 96 -285

In the Matter of

Access to Telecommunications
Equipment and Services by Persons
With Disabilities

CC Docket No. 87-124

REPORT AND ORDER

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By the Commission:

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I. INTRODUCTION

1. In this Report and Order, we amend our rules to ensure access by persons who use hearing aids to the nation's telephone network. Specifically, we amend our rules to provide that, eventually, virtually all wireline telephones in workplaces, confined settings, and hotels and motels must be hearing aid compatible.¹ We also require that, eventually, to be considered hearing aid compatible, telephones must offer both electro-magnetic coil compatibility² and volume control. Finally, we require that new telephones be labeled hearing aid compatible. These actions are taken pursuant to the Hearing Aid Compatibility Act of 1988 (HAC Act).³

II. BACKGROUND

2. The HAC Act required the Commission to establish regulations that would ensure reasonable access to telephone service by persons with hearing disabilities.⁴ As part of its implementation of the HAC Act, in 1992 the Commission adopted rules that expanded the requirements to provide hearing aid compatible telephones to particular establishments.⁵ The rules required that, with minor exceptions, all telephones in hospitals and other health care facilities, in hotels and motels, in prisons, and in all workplaces be made electro-magnetic coil hearing aid compatible by May 1, 1993, for establishments with twenty or more

¹ As currently defined, "hearing aid compatibility" describes a feature internal to a telephone (distinct from external portable devices that plug into a telephone) that enables a person with a hearing aid designed to be used with a telephone to use that telephone. See 47 U.S.C. § 610(b)(1)(B).

² "Electro-magnetic coil hearing aid compatibility" exists when a hearing aid contains a telecoil that detects, or is compatible with, a similar coil in a hearing aid compatible telephone. The coil in the telephone converts electrical energy into magnetic energy, which is then detected by the telecoil in the hearing aid. See NPRM at para. 10.

³ 47 U.S.C. § 610(a).

⁴ 47 U.S.C. § 610(a).

⁵ Access to Telecommunications Equipment and Services by the Hearing Impaired and Other Persons with Disabilities, CC Docket No. 87-124, Report and Order, 7 FCC Rcd 3472 (1992) (1992 Order) at Paragraph 1. See also First Report and Order, 4 FCC Rcd 4596 (1989) (First R&O); Memorandum Opinion and Order and Further Notice of Proposed Rule Making, 5 FCC Rcd 3434 (1990) (MO&O), recon. denied, 6 FCC Rcd 4799 (1991); Order, 8 FCC Rcd 4958 (1993) (Order); Notice of Proposed Rulemaking, 11 FCC Rcd 4338 (1995) (NPRM); Order Granting Motion for Extension of Time to File Comments, 11 FCC Rcd 1814 (1996) (Time Extension Order).

employees, and by May 1, 1994, for establishments with fewer than twenty employees.⁶

3. After the Commission's adoption of these rules, many establishments reported to the Commission that they were encountering serious difficulties in their attempts to comply. The difficulties generally related to the costs of retrofitting existing telephones, and to the establishments' ability to retrofit telephones by the prescribed deadline. On February 22, 1993, the Commission placed on public notice a petition received from Goodwill Industries of Seattle for waiver of the new rules. Written comments on this Goodwill petition and additional petitions for waiver were filed by forty-nine individuals and organizations. On April 2, 1993, the Tele-Communications Association⁷ filed an Emergency Request for Stay of the HAC requirements. On April 13, 1993, the Commission suspended portions of the new rules affecting workplaces, confined settings and hotels and motels.⁸

4. An Emergency Request to Reinstate the suspended rules was then filed by the Alexander Graham Bell Association for the Deaf on May 12, 1993. In light of the ongoing controversy, the Commission asked for public comment on whether an advisory committee to develop new rules should be formed.⁹ Commenters overwhelmingly supported the formation of an advisory committee, and thirty-nine nominations were received by the Commission. In March 1995, the Commission announced the establishment of a nineteen-member Hearing Aid Compatibility Negotiated Rulemaking Committee (Committee) under the Negotiated Rulemaking Act of 1990.¹⁰ The Commission selected members of the Committee to ensure representation from all parties interested in the status of the suspended rules. Committee members represented large and small businesses and other employers, the telecommunications industry, consumers with hearing disabilities, the health care industry, and the hotel and motel industry.¹¹ The Committee's task was to consider whether the suspended rules should be reinstated, or new rules proposed.

⁶ See 47 C.F.R. §§ 68.112 (b)(1), (3), (5).

⁷ The Tele-Communications Association changed its name to The Information Technology and Telecommunications Association in September, 1995. The organization is referred to as "ITTA" herein.

⁸ See NPRM at paras. 5-6; see also Order at 4958-4959. For a description of which rules were suspended, and which were not, see NPRM at para. 6.

⁹ FCC Asks for Comments and Nominations for Membership Regarding the Establishment of an Advisory Committee to Negotiate Regulations, Public Notice, CC Docket No. 87-124 (November 7, 1994).

¹⁰ See Negotiated Rulemaking Act of 1990, 5 U.S.C. § 561.

¹¹ NPRM at paras. 2, 8.

5. Committee members met face-to-face around a bargaining table over an eight-week period and reached full consensus on the entire work program. In August 1995, the Committee presented a Report to the Commission.¹² The Committee recommended that, in place of the suspended rules, the Commission adopt new rules for workplaces, confined settings, and hotels and motels that would cover both telephone electro-magnetic coil compatibility and volume control. On November 28, 1995, the Commission adopted and released a NPRM that proposed the rules recommended by the Committee.

6. In response to the NPRM, thirty-one comments and six reply comments were filed.¹³ The majority of commenters support the proposed rules. Numerous commenters representing individuals with hearing and speech disabilities, and industry, labor and government organizations filed comments expressing overall support, directing their comments to a narrow range of issues, including workplace and volume control rules.¹⁴ Six commenters expressed general opposition to the proposed rules, mainly on the grounds that the Commission exceeded its statutory and rulemaking authority.¹⁵

III. DISCUSSION

A. STATUTORY ISSUES

1. Commission Authority Under the HAC Act

a. Background

¹² Report of the Federal Communications Commission Hearing Aid Compatibility Negotiated Rulemaking Committee, CC Docket No. 87-124, August 1995 (HACNRC Report).

¹³ See Appendix A for a listing of parties filing comments and reply comments.

¹⁴ See, e.g., Comments of the Alexander Graham Bell Association for the Deaf (AGB), American Speech-Language-Hearing Association (ASHA), American Health Care Association (AHCA), Association of College and University Telecommunications Administrators (ACUTA), Chicago Hearing Society (CHS), Communications Workers of America (CWA), U.S. General Services Administration (GSA), HANDS, Inc., Hearing Industries Association (HIA), IMPACT, Inc., Information Technology and Telecommunications Administration (ITTA), League for the Hard of Hearing (LHH), National Association of the Deaf/National Center for Law and Deafness (NAD/NCLD) Newspaper Association of America (NAA), Pittsburgh Hearing and Speech Resources, Inc., Self Help for Hard of Hearing People, Inc. (SHHH), Telecommunications for the Deaf, Inc. (TDI) and Wisconsin Center for the Deaf and Hard of Hearing.

¹⁵ See Comments of American Bankers Association (ABA), Credit Union National Association (CUNA), Equal Employment Advisory Council (EEAC), Food Marketing Institute (FMI), National Association of Manufacturers (NAM), and National Federation of Independent Businesses (NFIB).

7. The HAC Act requires the Commission to "establish such regulations as are necessary to ensure reasonable access to telephone service by persons with impaired hearing."¹⁶ The HAC Act also requires the Commission to ensure that all "essential" telephones are hearing aid compatible.¹⁷ The statute defines "essential telephones" as "coin-operated telephones, telephones provided for emergency use, and other telephones frequently needed by persons using such hearing aids."¹⁸ The Commission determined that the term "telephones provided for emergency use" includes workplace telephones, telephones in confined settings, and hotel and motel telephones, and accordingly required in a 1992 Report and Order, and proposed again in its November 1995 NPRM, that telephones in these settings must be hearing aid compatible.¹⁹

b. Comments

8. ABA, CUNA, EEAC, FMI, NAM and NFIB assert that the Commission's proposed rules, in particular rules applicable to the workplace, exceed Congressional intent and Commission authority under the HAC Act. They argue, among other things, that Congress did not intend the term "essential telephones" to encompass all workplace telephones. In support of this argument, EEAC points to legislative history from the Telecommunications for the Disabled Act of 1982 (1982 Act),²⁰ which was the predecessor to the 1988 HAC Act. Congress passed the 1988 HAC Act because it found, among other things, that the 1982 Act "did not guarantee the nation's hearing impaired complete access to the telephone network."²¹ The 1982 Act legislative history states that "under no circumstances may the Commission designate as an essential telephone any residential telephone or any other telephone if all the persons who would normally use it do not have hearing impairments."²² In addition, EEAC and NAM²³ assert that the HAC Act was only intended to impose the responsibility of providing hearing aid compatible telephones upon

¹⁶ 47 U.S.C. § 610(a).

¹⁷ 47 U.S.C. § 610(b)(1)(A).

¹⁸ 47 U.S.C. § 610(b)(4)(A).

¹⁹ See Report and Order, 7 FCC Rcd at 3472 (1992); NPRM at paras. 26, 46 and 53.

²⁰ Pub. L. 97-410, 96 Stat. 2043 (Jan. 3, 1983).

²¹ H.R. Rep. No. 674, 100th Cong., 2d. Sess. 6 (1988).

²² H.R. Rep. No. 888, 97th Cong., 2d. Sess. 9 (1982) (1982 Act House Report).

²³ NAM Comments at 1-2; EEAC Comments at 6 - 8.

manufacturers, and not upon employers.²⁴

9. The National Association of the Deaf (NAD), four other national associations representing individuals with hearing and speech disabilities, and the Communications Workers of America (CWA) (collectively, "NAD Reply") filed joint reply comments addressing EEAC's arguments. NAD asserts that EEAC "misinterprets the purpose, effect and design of the proposed rules and ignores the intent of Congress to ensure full telephone access to individuals with hearing disabilities."²⁵

c. Discussion

10. We find that the proposed rules are within the Commission's authority under the HAC Act. The HAC Act requires the Commission to "establish such regulations as are necessary to ensure reasonable access to telephone service by persons with impaired hearing."²⁶ The Act also requires the Commission to ensure that all "essential" telephones are hearing aid compatible²⁷ and defines "essential" telephones to include "telephones provided for emergency use, and other telephones frequently needed for use by persons using hearing aids."²⁸

11. In adopting the HAC Act, Congress placed great weight on the "emergency use" provision of the "essential telephones" definition. The legislative history indicates that the term "telephones provided for emergency use" should be interpreted broadly and include workplace telephones. The Senate Report stated that "No matter how broadly the FCC defines 'essential,' it is impossible to specify in advance all the telephones that a hearing aid user might need. . . . [I]t is impossible to predict beforehand when an emergency situation may arise."²⁹ The Senate Report also stated that "[e]mergencies may occur, for instance, at a friend's home or in another person's business or office. In short, the situations in which a

²⁴ EEAC also argues that the proposed rules would require "wholesale retrofitting" and thus exceed the boundaries of the HAC Act. EEAC Comments at 5-8. We address this argument in paras. 28-30, infra.

²⁵ NAD Reply Comments at 3.

²⁶ 47 U.S.C. § 610(a).

²⁷ 47 U.S.C. § 610(b)(1)(A).

²⁸ 47 U.S.C. § 610(b)(4).

²⁹ S. Rep. No. 391, 100th Cong., 2nd Sess. 3 (1988) (Senate Report).

hearing aid user would need access to a telephone are innumerable."³⁰ Similarly, in an introduction of the HAC Act on the House floor, Congressman Edward Markey stated: "[i]magine not being able to call home from a friend's house or use the phone in someone else's office or even to call 911 outside your own home in an emergency."³¹

12. We also find that the cited language from the 1982 Act legislative history does not support EEAC's position. First, the purpose of the HAC Act was to "expand upon the 1982 Act and provide a greater degree of assurance that hearing aid users can have access to a hearing aid compatible telephone."³² EEAC's argument also ignores the emphasis which Congress placed on the emergency use provision when it revisited the "essential telephone" issue in 1988. Furthermore, even if the cited language were relevant, we do not see how this language in any way demonstrates Congressional intent to bar the Commission from declaring workplace telephones to be "emergency use" telephones.³³ This language is primarily directed at telephones in private residences and other settings which are for the exclusive or private use of a few known persons.³⁴ Places of employment and places of public accommodation, however, are frequented by many persons, including employees and visitors, and there is a greater likelihood that a person who is hearing impaired may need emergency access to a telephone in such settings. We believe, therefore, that EEAC overstates the scope of this Congressional language.

13. The argument that the HAC Act is limited only to manufacturing standards is erroneous. The HAC Act includes both a manufacturing requirement³⁵ and a separate provision requiring the Commission to adopt rules ensuring that all "essential" telephones (including "emergency use" telephones) are hearing aid compatible.³⁶ We believe it is consistent with the "essential" telephone requirement to require that the owner or lessee of essential telephones be responsible for ensuring that they are hearing aid compatible. This is inherent in the statutory concept of the Commission's rules requiring telephones to be

³⁰ Id.

³¹ 134 Cong. Rec. H3985 (Daily Ed. June 7, 1988)(statement of Rep. Markey).

³² Senate Report at 1.

³³ See para. 11, supra.

³⁴ We note that the House committee report on the 1982 Act used the terms "any residential telephone or any other telephone," whereas the House committee report on the 1988 Act, in addressing this issue, used only the words "any residential telephone." 1982 Act House Report at 9; H.R. Rep. No. 674, 100th Cong., 2nd Sess. 12 (1988).

³⁵ 47 U.S.C. § 610(b)(1)(B).

³⁶ 47 U.S.C. § 610(b)(1)(A).

replaced.

2. Other Statutes

a. Americans with Disabilities Act

(1) Background

14. The Americans with Disabilities Act of 1990 (ADA) is a comprehensive national mandate for the elimination of discrimination against individuals with disabilities.³⁷ Title I of the ADA prohibits discrimination against qualified individuals with disabilities in their place of employment, and requires covered employers to provide reasonable accommodations for employees with disabilities, if the provision of such accommodations would not pose an undue hardship.³⁸ Title I of the ADA only applies to employers with 15 or more employees.³⁹ Title I of the ADA does not apply to employees of Executive branch agencies of the U.S. Government.⁴⁰

15. Titles II and III of the ADA require all public entities (state and local government instrumentalities) and places of public accommodation (e.g., places of lodging and health care facilities) to furnish auxiliary aids and services to individuals with disabilities when necessary for effective communication.⁴¹ "Auxiliary aids and services" under Title III includes "telephones compatible with hearing aids."⁴² Finally, pursuant to Title IV of the ADA, the Commission is required to ensure that all states provide "functionally equivalent" telecommunications relay services (TRS) for individuals with hearing and speech disabilities who use text telephones (TTYs).⁴³ Title IV, however, does not address the needs of persons

³⁷ Pub. L. 101-336, 104 Stat. 328 (July 26, 1990), codified at 42 U.S.C. § 12101 - 12213; See 42 U.S.C. § 12101(b)(1).

³⁸ See generally 42 U.S.C. 12111 - 12117.

³⁹ 42 U.S.C. § 12111(5)(A).

⁴⁰ 42 U.S.C. § 12111(5)(B)(i). But see 42 U.S.C. § 12209 (ADA generally applicable to Congress and the Legislative Branch of the U.S. Government).

⁴¹ See generally 42 U.S.C. §§ 12131 - 12189. Department of Justice regulations implementing Titles II and III of the ADA are codified at 28 C.F.R. Parts 35 and 36.

⁴² 28 C.F.R. § 35.104.

⁴³ Pub. L. 101-336, 104 Stat. 366 - 69, § 401, codified at 47 U.S.C. § 225. TRS is a telephone transmission service which uses specialized staff and equipment to "relay" telephone calls between voice telephone and text telephone (TTY) users. The Commission's regulations

with hearing disabilities who have the ability to use voice telephones, with or without hearing aids.

(2) Comments

16. EEAC, CUNA, FMI, NAM, NFIB and ABA argue that the Commission's proposed workplace rules are unnecessary because they duplicate the provisions of the Americans with Disabilities Act. The ABA, for example, states that "[i]f the goal is to further reasonable access to telephone service by persons with hearing disabilities, the ABA feels that employers will have already met that goal by fulfilling their requirements under the Americans with Disabilities Act."⁴⁴ The Commission also received informal comments regarding the NPRM from parties representing individual hotels and motels, arguing that the Commission's proposed rules for hotels and motels are unnecessary because the ADA already requires them to provide hearing aid compatible phones upon request to guests with hearing disabilities.

17. NAD points out in reply comments that the plain language of the ADA states that "nothing in this Act [ADA] shall be construed to invalidate or limit the remedies, rights, and procedures of any Federal law . . . that provides greater or equal protection for the rights of individuals with disabilities."⁴⁵ NAD also argues that "the contention that the ADA adequately addresses the needs of individuals with hearing disabilities fails to consider the practical reality of most employment situations."⁴⁶ NAD notes that "in the course of conducting daily business, emergency situations may arise that can require an individual to use a phone other than his or her own."⁴⁷

(3) Discussion

18. The plain language of Title V of the ADA clearly states that it is not intended to invalidate any other Federal law which provides equal or greater protection for individuals with disabilities.⁴⁸ The HAC Act provides a much greater degree of protection to individuals

implementing TRS are codified at 47 C.F.R. §§ 64.601 - .608.

⁴⁴ ABA Comments at 2-3.

⁴⁵ NAD Reply Comments at 8, citing 42 U.S.C. § 12201(b).

⁴⁶ NAD Reply Comments at 7.

⁴⁷ Id. at 7-8.

⁴⁸ 42 U.S.C. § 12201(b).

with disabilities than the ADA, in terms of access to hearing aid compatible telephones.⁴⁹ We conclude, therefore, that the presence of the ADA does not obviate the need to implement the HAC Act, and we find any arguments to the contrary to be without merit.

19. We also conclude that the ADA, in and of itself, does not fulfill the Congressional mandate of the HAC Act to "eliminate the disparity between hearing aid-users and non-users in obtaining access to the telephone network."⁵⁰ Merely providing hearing aid compatible telephones to individuals on an as-needed basis, as a "reasonable accommodation" under the ADA, does not provide the same degree of protection and access as required by the HAC Act, which provides, among other things, that all "essential" telephones must be hearing aid compatible.

20. Titles I through III of the ADA do not completely address the many venues and locations where employees and patrons with hearing disabilities may need access to a telephone in the event of an emergency, including places of employment with fewer than 15 employees and U.S. Government agencies. The HAC Act, on the other hand, places responsibility on these employers to offer such access, and ensures that nearly all public and private employees can have access to hearing aid compatible telephones in the workplace. Finally, while Title IV of the ADA does provide access to the telephone network for persons who use TTY equipment, a significant majority of individuals with mild to severe hearing disabilities does not use TTYs, but rather relies on residual hearing and/or hearing aids to use voice telephones directly. The Commission's rules under Title IV of the ADA, taken together with HAC Act rules which we adopt herein, form a seamless web of access to the telephone network by all individuals with hearing and speech disabilities.

b. The Telecommunications Act of 1996

21. Subsequent to the release of the Commission's NPRM in this proceeding, Congress enacted the Telecommunications Act of 1996 (1996 Act).⁵¹ Of particular relevance are Sections 255(b) and (d) of the 1996 Act, which require manufacturers of telecommunications equipment to ensure that equipment and customer premises equipment (CPE) is accessible to individuals with disabilities, or compatible with existing peripheral devices commonly used by individuals with disabilities, if readily achievable.⁵² The HAC Act, however, does not contain a "readily achievable" standard, but requires all telephones

⁴⁹ E.g. see para. 20 infra.

⁵⁰ Senate Report at 7.

⁵¹ Pub. L. 104-104, 110 Stat. 56 (1996).

⁵² Id., § 255(b), (d). Section 255(a)(2) of the 1996 Act incorporates the ADA definition of "readily achievable" at 42 U.S.C. § 12181(9): "easily accomplishable and able to be carried out without much difficulty or expense."

manufactured after August 16, 1989, and all essential telephones to be hearing aid compatible. Pursuant to Section 255(e) of the 1996 Act, guidelines for accessible telecommunications equipment and CPE are to be developed by the U.S. Architectural and Transportation Barriers Compliance Board, in conjunction with the Commission.⁵³

22. We note that both the HAC Act and Section 255 of the 1996 Act share a similar goal, namely, access to the telecommunications network by individuals with disabilities.⁵⁴ The 1996 Act, and its legislative history, do not discuss hearing aid compatibility or the HAC Act. Section 601(c)(1) of the 1996 Act provides: "This Act and the amendments made by this Act shall not be construed to modify, impair, or supersede Federal, State or local law unless expressly so provided in such Act or amendments." As there is no language in the 1996 Act or legislative history to the contrary, we conclude that the HAC Act is unaltered by the 1996 Act, and that the Commission should continue to implement the more specific mandates of the HAC Act.

B. TELEPHONES IN SPECIFIC SETTINGS

1. Workplace Telephones

a. General Requirements and Implementation Schedules

(1) Background

23. The Commission's rules affecting workplace common areas were not suspended in our April 1993 Order. Common areas include libraries, reception areas and similar locations where employees are reasonably expected to congregate.⁵⁵ Employers have had a continuing obligation since 1992 to ensure that all common area workplace telephones are hearing aid compatible, and these requirements were not modified by the HAC Negotiated Rulemaking Committee or our NPRM. Much of the controversy surrounding our April 1993 suspension was in regard to workplace non-common areas. In the NPRM, therefore, we proposed that our regulations governing workplace non-common areas be moved to a separate rule section, in order to highlight new compliance time lines for workplace non-common areas.⁵⁶

⁵³ Id., § 255(e).

⁵⁴ The Commission will undertake a separate proceeding concerning Section 255.

⁵⁵ 47 C.F.R. § 68.112(b)(1).

⁵⁶ See Section 68.112(b)(3) in Appendix C and NPRM at paras. 24 - 26. In NPRM Appendix B, Section 68.112(b)(3) is listed as Sections 68.112(b)(1)(B)-(G). For clarification, we have changed the numbers, lettering and grammar of the rules proposed in the NPRM to the rules in Appendix C attached hereto.

24. The NPRM proposed that all non-common-area workplace telephones must be hearing aid compatible by January 1, 2000, except that telephones purchased between January 1, 1985, through December 31, 1989 must be hearing aid compatible by January 1, 2005.⁵⁷ The NPRM also proposed that employers with fewer than fifteen employees would be generally exempt from coverage of the workplace non-common area rules.⁵⁸ Finally, the NPRM proposed that all U.S. Government employers with fifteen or more employees would be subject to the workplace non-common area rules.⁵⁹

(2) Comments

25. No commenter disputed the application of the HAC Act to workplace common areas, nor the moving of the rules governing non-common areas into a new section. Comments in opposition to workplace requirements were generally directed at the Commission's authority to require all workplace telephones to be hearing aid compatible, by extending workplace requirements to non-common area telephones.⁶⁰ The Association of College and University Telecommunications Administrators (ACUTA) commented that the implementation time lines and the fifteen employee cutoff for non-common areas "strike a reasonable balance between the needs of persons with hearing disabilities and the burden of compliance on small employers."⁶¹ The U.S. General Services Administration (GSA), the agency vested with responsibility for acquiring telecommunications services for use of Federal Executive Agencies, also filed comments and reply comments expressing support for the proposed workplace rules. ABA, however, urges the Commission to "change or eliminate" the effective dates for workplace non-common area compliance, stating that "establishing a date does nothing to change the confidence of the public but will place a burden on employers to make sure that after an arbitrary date they are in compliance."⁶²

(3) Discussion

⁵⁷ NPRM at para. 24.

⁵⁸ NPRM at 14. But see paras. 31-34, infra, for discussion of individual workstation requirements, which will apply regardless of the number of employees.

⁵⁹ NPRM at para. 25.

⁶⁰ See paras. 7-13, supra, for discussion of Commission authority to require all workplace telephones to be hearing aid compatible.

⁶¹ ACUTA Comments at 1.

⁶² ABA Comments at 3.

26. Based on the comments received, we adopt Section 68.112(b)(3)⁶³ in its entirety, including the implementation time lines and the exemption for employers with fewer than fifteen employees from the rules governing telephones in workplace non-common areas. In the adopted rule, we define non-common areas as "all workplace areas that are not common areas," and we give as examples "private enclosed offices, open area individual work stations and mail rooms." We further conclude that U.S. Government employers must also comply with these rules. We do not agree with ABA that establishing a certain date for compliance places a burden on employers, if that date gives employers reasonable time to come into compliance. The dates set in these rules are the result of a negotiated rulemaking; the recommendations of the Committee reflected a careful balancing of the interests of all potentially affected by these rules, including large and small businesses and other employers. Consequently, we find that the compliance dates will give employers a reasonable period of time to comply. As noted below, our rules also establish a "rebuttable presumption" after the compliance dates whereby employers will only have to replace non-compliant telephones on a case-by-case basis.⁶⁴ We believe that the public should have assurances that the majority of workplace telephones are hearing aid compatible by a certain date.

27. In calculating the number of "employees" for purposes of compliance with Section 68.112(b)(3), the total employment force of an establishment, and not the number of employees an employer may have at a particular work site, should be the determining factor.⁶⁵ Furthermore, the terms "employer" and "employee" as used in our regulations have the same meaning as these terms in the Americans with Disabilities Act.⁶⁶ We do not adopt, however, the ADA's exceptions to the term "employer." The mandate of the HAC Act, which requires that all "essential telephones" be made hearing aid compatible, is much broader than that of the ADA, and the HAC Act does not specify exceptions for any employers. The Committee felt strongly that no entity employing fifteen or more employees should be excluded from the definition of "employer."⁶⁷ As a general matter, therefore, no entity employing fifteen or more employees, including U.S. Government agencies, will be exempt from workplace non-

⁶³ See Section 68.112(b)(3) in Appendix C.

⁶⁴ See paras. 35-39, *infra*.

⁶⁵ NPRM at para. 25.

⁶⁶ 42 U.S.C. § 12111 defines "employee" as "an individual employed by an employer" and "employer" as "a person engaged in an industry affecting commerce who has 15 or more employees for each working day in each of 20 or more calendar weeks in the current or preceding calendar year, and any agent of such person."

⁶⁷ HACNRC Report at 19.

common area rules.⁶⁸

b. No Retrofitting Requirements

(1) Comments

28. EEAC objects to the Commission's proposed workplace rules, claiming that the rules would require "wholesale retrofitting of all workplace telephones."⁶⁹ FMI contends that the Commission's proposed rulemaking would require an employer to purchase hearing aid compatible telephones to replace non-hearing aid compatible telephones even when there are no employees with a hearing impairment requesting this type of accommodation.⁷⁰ NAD, however, argues that no such "wholesale retrofitting" would occur, and that the Commission's proposed rules are "lenient" and compliance time lines "generous."⁷¹ NAD also asserts that "the rules will in reality affect a very small number of telephones and businesses, and even these businesses should be able to fully convert to hearing aid compatible equipment during their normal telephone replacement cycle."⁷² ITTA also recognizes that the proposed workplace rules would not require retrofitting.⁷³

(2) Discussion

29. We reiterate that our proposed workplace rules would not require across-the-board field testing or retrofitting of all workplace telephones for hearing aid compatibility. The HAC Act has required that all telephones manufactured or imported for use in the U.S. since August 1989 be hearing aid-compatible.⁷⁴ In addition, the Committee determined that the average life-cycle for telephone acquisition and replacement was approximately seven years.⁷⁵

⁶⁸ The ADA exempts "the United States, a corporation wholly owned by the United States, or an Indian tribe; or a bona fide private membership club (other than a labor organization) that is exempt from taxation under section 501(c) of the Internal Revenue Code." 42 U.S.C. § 12111.

⁶⁹ EEAC Comments at 2.

⁷⁰ FMI Comments at 2.

⁷¹ NAD Reply Comments at 5-6.

⁷² Id. at 6.

⁷³ ITTA Comments at 4.

⁷⁴ 47 U.S.C. § 610(b)(1)(B).

⁷⁵ See NPRM at para. 15, fn. 26.

30. Thus, by the years 2000 and 2005, when the proposed rules require that all non-common area workplace telephones be hearing aid compatible,⁷⁶ most non-compliant phones will already have been replaced with hearing aid compatible phones during normal replacement cycles. Furthermore, even after the years 2000 and 2005, there will be no retrofitting requirements and employers will not be required to locate non-compliant telephones. Rather, there will be a "rebuttable presumption" that all workplace phones are hearing aid compatible.⁷⁷ We agree with NAD that, given the normal replacement cycle and the rebuttable presumption, the number of workplace telephones subject to replacement will be very small.⁷⁸

c. Workstation Requirements and Headset Exemption

(1) Background

31. The NPRM proposed to generally exclude headsets from the definition of "emergency use phones," and thus from hearing aid compatibility requirements.⁷⁹ The NPRM also proposed, however, that current Section 68.112(b)(1)⁸⁰, which requires hearing aid compatible telephones to be "made available to a hearing-impaired employee for use by the employee in his or her employment duty," be modified to (1) require employers to provide hearing aid compatible headsets to employees needing such headsets for their employment duties, and (2) require all employers, regardless of the number of employees, to comply with this provision.⁸¹

(2) Comments

32. Aeronautical Radio, Inc. (ARINC), a representative of the air transport industry (a major user of headset equipment) states that its "concerns have now been appropriately addressed by the FCC's rule modifications."⁸² ACUTA, and commenters representing individuals with hearing disabilities, agree that hearing aid compatible telephones and

⁷⁶ See para. 24, *supra*.

⁷⁷ See Appendix C, Rule 68.112 (b)(1)(D). See paras 35-39, *infra*, for discussion of the "rebuttable presumption."

⁷⁸ NAD Reply Comments at 6.

⁷⁹ NPRM at paras. 27-28.

⁸⁰ See 47 C.F.R. § 68.(b)(1).

⁸¹ NPRM at para. 27.

⁸² ARINC Comments at 3.

headsets should be made available to an employee with a hearing disability regardless of the number of employees in a workplace.⁸³ CUNA asserts that the requirement that an employee be provided with hearing aid compatible headset equipment for his or her employment duty is an "unnecessary repetition" of the requirements of Title I of the ADA.⁸⁴ CUNA also states that it was "confused" to see that the under-fifteen exemption would not apply to individual workstation provisions.⁸⁵ NFIB generally objects to the elimination of the under-fifteen exemption even for employee workstation requirements, citing it as an undesirable precedent for small businesses.⁸⁶

(3) Discussion

33. We conclude that headset equipment should generally be exempt from hearing aid compatibility requirements.⁸⁷ Headsets are generally an individualized, specialty-use item. We do not agree, however, with CUNA's assertion that requiring employers to provide individual headsets on an as-needed basis is unnecessary in light of the ADA. Title I of the ADA contains general language requiring reasonable accommodations that do not impose an undue hardship.⁸⁸ Our rule,⁸⁹ however, is specifically tailored to the particular needs of an employee with a hearing disability, and to that employee's need for access to a hearing aid compatible telephone, including to a headset that is hearing aid compatible. Our rule, unlike the ADA, also will apply to all employers, including those with fewer than fifteen employees, and to Executive branch agencies of the Federal Government. The ADA specifically states that it does not invalidate any other Federal laws which provide equal or greater protection to individuals with disabilities. The HAC Act, and our rules pursuant to it, are examples of protections that are greater than those afforded by the ADA.

34. We conclude that Section 68.112(b)(3)(A),⁹⁰ addressing individual workstation requirements, should be adopted in its entirety. All employers, regardless of the number of their employees, must provide hearing aid compatible telephones and headsets to employees

⁸³ ACUTA Comments at 1-2.

⁸⁴ CUNA Comments at 4.

⁸⁵ CUNA Comments at 5.

⁸⁶ NFIB Comments at 1.

⁸⁷ See Sections 68.112(b)(1), 68.112(b)(3), 68.112(b)(3)(C) in Appendix C.

⁸⁸ 42 U.S.C. § 12201(b). See paras. 18-20, supra.

⁸⁹ See § 68.112(b)(3)(A) in Appendix C.

⁹⁰ See Section 68.112(b)(3)(A) in Appendix C.

who need such phones to perform their employment duties. We consider such telephones to be "essential telephones" within the meaning given the term in the HAC Act, both as telephones "provided for emergency use" and as telephones "frequently needed for use by persons using . . . hearing aids."⁹¹ We do not believe that adoption of this rule sets a harmful precedent for small businesses. Small businesses with fewer than fifteen employees will still enjoy a general exemption from workplace non-common area requirements, and will thus only have to provide hearing aid compatible telephones in workplace common areas and on an as-needed basis for employees with hearing disabilities.

d. Rebuttable Presumption

(1) Background

35. In recognition of the difficulties involved in tracing, testing and identifying existing telephone equipment for hearing aid compatibility, we proposed in the NPRM that there be a rebuttable presumption that, as of a certain date, every telephone in the workplace is hearing aid compatible.⁹² The rebuttable presumption would apply as of either January 1, 2000 (for telephones purchased by employers prior to January 1, 1985 or after December 31, 1989), or January 1, 2005 (for telephones purchased by employers between January 1, 1985 and December 31, 1989). This presumption can be rebutted, on a telephone-by-telephone basis, by any person legitimately on the premises who makes an identification of a particular telephone as non-hearing aid compatible.⁹³ Once such an identification is made, the employer will then have fifteen working days to replace the non-compliant telephone with a hearing aid compatible telephone.⁹⁴

(2) Comments

36. Many commenters support the adoption of a rebuttable presumption. ACUTA, for instance, comments that the rebuttable presumption is "more than fair" and that the 15-day requirement is also "adequate." ITTA believes that the rebuttable presumption approach is "far preferable to mandatory retrofitting."⁹⁵ NFIB, on the other hand, asserts that the 15-day time line is too short, and urges the Commission to adopt the reasonable accommodation approach taken by the ADA, which requires employers to respond to an employee's request

⁹¹ 47 U.S.C. § 610(b)(4).

⁹² NPRM at para. 31.

⁹³ Id.

⁹⁴ Id.

⁹⁵ ITTA Comments at 4.

for accommodation within a "reasonable" period of time.⁹⁶ Finally, a number of commenters, including ITTA, also urge the Commission to clarify that the rebuttable presumption does not permit third parties to enter the premises of an employer for the purpose of auditing or surveying the telephones for hearing aid compatibility.⁹⁷

(3) Discussion

37. We conclude that Section 68.112(b)(3)(B) should be adopted in its entirety.⁹⁸ As of January 1, 2000, or January 1, 2005, whichever is applicable,⁹⁹ there shall be a rebuttable presumption that all workplace non-common area telephones are hearing aid compatible. This rebuttable presumption will relieve employers of the need to field-test and identify whether their telephones are hearing aid compatible.

38. We further conclude that Section 68.112(b)(3)(B) of our rules creates no third-party right of entry onto the premises of employers. The person making the identification of a telephone as non-hearing aid compatible must be an individual present in the normal course of the establishment's business, legitimately on the premises as an employee or invitee of the establishment.

39. We also conclude that a fifteen-day replacement period is reasonable. The requirement does not apply to businesses with fewer than fifteen employees and is the outcome of a negotiated rulemaking process. In addition, the requirement will not go into effect until the years 2000 or 2005, i.e., eleven to sixteen years after all telephones imported or manufactured for use in the United States were required to be hearing aid compatible. Finally, in any enforcement action for violation of the fifteen day requirement, the Commission will give substantial weight to a showing of (1) a good faith effort to comply and (2) any unusual technical difficulties concerning the telephone system involved or the replacement or installation of a hearing aid compatible telephone, so long as the employer demonstrates that it will come into compliance within a reasonable period of time. This approach should address the concerns express by NFIB.

e. Replacement and Newly Acquired Telephones

⁹⁶ NFIB Comments at 2.

⁹⁷ ITTA Comments at 5.

⁹⁸ See Section 68.112(b)(3)(B) in Appendix C.

⁹⁹ Workplace telephones are required to be hearing aid compatible as of January 1, 2000, unless the establishment purchased the telephones between January 1, 1985 and December 31, 1989, in which case the telephones must be hearing aid compatible by January 1, 2005. See para. 24, supra.

(1) Background/Comments

40. Section 68.112(b)(3)(C) would require that all "newly acquired" telephones in the workplace be hearing aid compatible.¹⁰⁰ For purposes of this Section, "newly acquired" was defined as new, refurbished or secondhand telephones, including telephones taken from an establishment's stored inventory.¹⁰¹ Section 68.112(b)(3)(D), however, makes an exception for telephones taken from stored inventories existing prior to the time of enactment of the rules in this Report and Order.¹⁰² In such instances, the establishment would only be required to replace the telephone with a hearing aid compatible telephone upon a bona fide request from an employee or invitee. The Commission received little specific comment on this area. ACUTA agrees with the proposed rule, as well as the separate treatment of telephones taken from existing stored inventory.¹⁰³

(2) Discussion

41. We conclude that proposed Sections 68.112(b)(3)(C) and 68.112(b)(3)(D) should be adopted in their entirety.¹⁰⁴ The replacement or acquisition of a telephone creates a natural opportunity to install a hearing aid compatible telephone. This natural replacement requirement imposes little burden on employers. We conclude, furthermore, that the limited exception for replacements from inventories existing prior to the enactment of these rules is necessary to prevent the undesirable result of whole inventories of telephones becoming obsolete.

f. Safe Harbor

(1) Background

42. In light of the generous implementation time lines for hearing aid compatibility in the workplace, the NPRM proposed a "safe harbor" rule which would ensure that at least one designated hearing aid compatible telephone for emergency use is present on every floor of a workplace.¹⁰⁵ The designated phone could be coin-operated, a common area telephone or any other designated wireline or wireless telephone, and the manner of designation and the

¹⁰⁰ See Section 68.112(3)(C) in Appendix C. See also NPRM at para. 32.

¹⁰¹ See NPRM at para. 36.

¹⁰² Id. See also Section 68.112(b)(3)(D) in Appendix C.

¹⁰³ ACUTA Comments at 2.

¹⁰⁴ See Sections 68.112(b)(3)(C) and 68.112(b)(3)(D) in Appendix C.

¹⁰⁵ NPRM at para. 39.

definition of "floor" would be left to the employer's discretion.¹⁰⁶

(2) Comments

43. The Commission received numerous comments regarding this proposed rule. While no commenter specifically objected to the provision of a "safe harbor" telephone, a number of commenters representing individuals with hearing and speech disabilities urge the Commission to specify what is meant by a workplace "floor." The National Association of the Deaf/National Center for Law and Deafness (NAD/NCLD), for example, states that a definition of "floor" should be "limited to a reasonable traveling distance for an individual who might be in search of a telephone."¹⁰⁷ ASHA proposes that the safe harbor phones be "those phones nearest the emergency exits in buildings."¹⁰⁸ SHHH recommends that "where a floor has more than two corridors, at a minimum the employer be required to provide one designated HAC phone per set of two corridors on each floor."¹⁰⁹ Numerous commenters representing people with hearing disabilities also ask that the Commission adopt a signage requirement to ensure visual notification of the location of the safe harbor telephone.

44. Several industry commenters, however, urge the Commission not to define what constitutes a workplace "floor," and to leave the matter to the employer's good-faith discretion. ACUTA, for example, feels that the proposed rule "allows flexibility for various types of workplace settings."¹¹⁰ ITTA also filed reply comments specifically urging the Commission not to define "floor," arguing that such rule-making "puts the Commission in the business of policing compliance with a vague requirement."¹¹¹

(3) Discussion

45. We conclude that the words "on every floor of" in our proposed rule should be replaced with the words "within a reasonable and accessible distance for an individual searching for a telephone from any point in."¹¹² Comments from all parties have persuaded us that the use of the word "floor" is inadequate. Any rule based on the presence of floors or

¹⁰⁶ Id.

¹⁰⁷ NAD/NCLD Comments at 3.

¹⁰⁸ ASHA Comments at 7.

¹⁰⁹ SHHH Comments at 2.

¹¹⁰ ACUTA Comments at 2.

¹¹¹ ITTA Reply Comments at 7.

¹¹² See Section 68.112(b)(3)(E)(i) in Appendix C.

corridors would not take into account workplaces such as fairgrounds and amusement parks, for example. Also, limiting our rule to a one-per-floor basis will not provide reasonable access for persons who work in large, sprawling office complexes. Finally, we conclude that we do not need to adopt an additional signage requirement, as the proposed rule already requires that the safe harbor phone be "designated" as such.¹¹³

46. In revising the proposed rule, we believe that we are preserving the intent of the Committee that the location of the "safe harbor" phone be largely left to the employer's discretion.¹¹⁴ In setting up safe harbor telephones, and in providing information designating the location of such telephones, employers should put themselves in the position of a person "in search of a telephone," and locate such phones to ensure the most effective workplace coverage. If it is appropriate for the type of building, employers should install at least one safe harbor telephone on every floor. Employers should ensure that such telephones are placed in accessible locations.

2. Confined Settings

a. Background

47. The NPRM proposed that, for confined settings with fifty or more beds, the room telephones provided by the establishment must be hearing aid compatible within one year of the adoption of the proposed rules.¹¹⁵ Establishments with fewer than fifty beds will have two years from the date of adoption of the rules to ensure that all room telephones are hearing aid compatible.¹¹⁶ "Confined settings" include rooms in hospitals, residential health care facilities, and convalescent homes, in which the residents are not able to come and go at their discretion.¹¹⁷

48. The NPRM did not propose a rebuttable presumption for confined settings, because the vulnerability of persons in such settings increases the need to ensure that all room telephones are hearing aid compatible.¹¹⁸ Furthermore, the NPRM proposed that all newly

¹¹³ NPRM at para. 39. See proposed 47 C.F.R. § 68.112(b)(1)(G).

¹¹⁴ HACNRC Report at 21-22.

¹¹⁵ NPRM at paras. 41-42.

¹¹⁶ Id.

¹¹⁷ 47 C.F.R. § 68.112(b)(3); NPRM at para. 41 n. 66.

¹¹⁸ Id. at para. 41.

acquired and replacement telephones in confined settings be hearing aid compatible.¹¹⁹ The NPRM also proposed to exclude prisons from the definition of confined settings, and proposed that confined setting establishments would not be responsible for ensuring that telephones installed and maintained by a patient were hearing aid compatible.¹²⁰

49. Finally, the NPRM also proposed a qualified exception for confined setting establishments which offer an alternative means for the patient or resident to signal a life-threatening emergency, provided that such alternative means is "available, working and monitored."¹²¹

b. Comments

50. The Commission received little comment on the proposed rules for confined settings. The American Health Care Association (AHCA), a member of the Negotiated Rulemaking Committee, in comments also endorsed by Care Providers of Minnesota (CPM), expresses general support for the Commission's proposed rules. ACUTA indicates that it believes that its affected members, i.e., colleges and universities with medical facilities, will "be able to comply with the proposed rule without an unreasonable burden."¹²² LHH, however, urges the Commission not to exclude prisons from the definition of confined settings and states that "alternative means of signalling" do not always provide reasonable access in the event of an emergency.¹²³

c. Discussion

51. We adopt the proposed rules for confined setting telephones, and we specify particular dates in order to provide more certainty for confined setting establishments.¹²⁴ We specify November 1, 1997 as the date by which establishments with fifty or more beds must ensure that all room telephones are hearing aid compatible. Establishments with fewer than fifty beds will have until November 1, 1998 to comply with these rules. We recognize that residents and patients in confined settings are generally more vulnerable in the event of an emergency, especially if they are ill or of advanced age, and we find, therefore, that no rebuttable presumption should apply to confined settings. While we adopt the exception for

¹¹⁹ Id. at para. 43.

¹²⁰ Id. at paras. 44-45.

¹²¹ Id. at para. 45.

¹²² ACUTA Comments at 2.

¹²³ LHH Comments at 3.

¹²⁴ See Section 68.112(b)(5) in Appendix C.

confined settings which provide "alternative means of signalling," we stress that any such alternative means must in fact provide the resident or patient with an effective means of signalling personnel in the event of an emergency. In other words, the equipment must be monitored and kept in good working order.¹²⁵

52. Finally, we conclude that prisons should not be included within our definition of "confined settings," in recognition of the unique telecommunications requirements faced by prisons. As prisons do not usually provide telephones in every room or cell, we do not think our confined settings rules can be feasibly applied to prisons.¹²⁶ We note, however, that our workplace hearing aid compatibility rules would still apply to the workplaces of prison employees.¹²⁷

3. Hotels and Motels

a. Background

53. The Commission's rules currently require that at least ten percent of the rooms in a hotel or motel be "equipped to accommodate a hearing impaired customer."¹²⁸ In the NPRM, we proposed that at least twenty percent of all rooms in a hotel or motel be required to have a hearing aid compatible telephone as soon as the rules adopted in this Report and Order become effective.¹²⁹ Under this proposal, hotels and motels with eighty or more guest rooms would further be required to ensure that all guest room telephones are hearing aid compatible within two years of the effective date of these rules, and those with fewer than eighty guest rooms would have three years to ensure that all room telephones are hearing aid-compatible.¹³⁰

54. The NPRM established a different compliance schedule for hotels and motels which use telephones purchased during the period January 1, 1985 through December 31,

¹²⁵ See § 68.112(5)(C)(ii) in Appendix C.

¹²⁶ See NPRM at para. 44. See also HACNRC Report at 26.

¹²⁷ Id. See Part B (1), supra (Workplace Telephones).

¹²⁸ 47 C.F.R. § 68.112(b)(5). This requirement was adopted in 1992 and was not suspended by the Commission's April 1993 Order. See Order, 8 FCC Rcd at 4958. See also NPRM at para. 50.

¹²⁹ NPRM at para. 50.

¹³⁰ Id. at para. 48.

1989.¹³¹ Such hotels and motels would be required to ensure that: (1) twenty percent of their guest room telephones are hearing aid compatible as of the effective date of these rules; (2) twenty-five percent of their room telephones are hearing aid compatible within three years of the effective date of these rules; and (3) all guest room telephones are hearing aid compatible before January 1, 2000 (for hotels and motels with eighty or more rooms), or January 1, 2003 (for hotels and motels with fewer than eighty rooms).¹³²

55. The NPRM also proposed that, if a hotel or motel room is "renovated or newly constructed, or the telephone in a hotel or motel room is replaced or substantially, internally repaired," the telephone in that room must be hearing aid compatible.¹³³

b. Comments

56. The majority of commenters representing individuals with hearing disabilities support the proposed hotel and motel rules. The American Hotel and Motel Association (AHMA), which was a member of the Negotiated Rulemaking Committee and which represents over 10,000 hotels, motels and lodging properties, supported the consensus recommendations of the Committee, and did not consider the rules to be unduly burdensome. The Commission received informal comments from forty-two individual hotel owners, and three State hotel associations, stating that existing HAC telephones are adequate to meet demand and that the proposed rules are burdensome and unnecessary.¹³⁴

c. Discussion

57. We find the argument that the proposed rules are burdensome and unnecessary to be without merit. Committee members representing organizations of individuals with hearing disabilities stated that there are often too few hotel and motel rooms currently with hearing aid compatible telephones for individuals with hearing disabilities. They stated that the demand for these rooms often exceeds the supply of available rooms, and that it is difficult to locate hotels and motels with adequate facilities to accommodate conferences for organizations representing persons with hearing disabilities.¹³⁵

58. The installation of hearing aid compatible telephones in hotels and motels

¹³¹ NPRM at para. 51.

¹³² Id.

¹³³ NPRM at para. 49.

¹³⁴ Many of these hotel and motel owners also argue that the proposed rules duplicate the requirements of the ADA. This argument is addressed in paras. 18-20, supra.

¹³⁵ NPRM at para. 51.

fulfills an important public safety function. The Committee found that travelers with hearing disabilities may be especially vulnerable in emergency situations in hotel settings, because they are alone and dependent upon room telephones. They may be unfamiliar with the floor plan of the hotel or motel where they are staying.¹³⁶ In addition, the Committee pointed out that because travelers are transient, they have less opportunity to request changes in equipment than they would in more permanent settings, such as workplaces.¹³⁷ The HAC Act, by ensuring that all telephones located where a person "may be isolated in the event of an emergency" are hearing aid compatible, ensures that such travelers will have access to the telephone network in life-threatening situations. Accordingly, we conclude that the proposed rules for hotel and motel telephones should be adopted as of the dates indicated below.¹³⁸

59. Rather than requiring twenty percent of all hotel and motel room telephones to be hearing aid compatible as of the effective date of these rules, we conclude that the twenty percent threshold should be effective as of April 1, 1997. This will give hotel and motel owners a reasonable amount of time in which to meet the twenty percent threshold. Hotels and motels with eighty or more guest rooms must ensure that all room telephones are hearing aid compatible before November 1, 1998, and those with fewer than eighty guest rooms will have until November 1, 1999 to ensure that all room telephones are hearing aid compatible. We do modify the NPRM proposal for those hotels and motels which use telephones purchased during the period January 1, 1985, through December 31, 1989. The selection of the years 2000 and 2003 by the Committee was based on an assumed effective date for the proposed rules of late 1995.¹³⁹ Since the actual effective date will be a year later, we have changed the two negotiated dates to the years 2001 and 2004. Thus, for this category of telephones, hotels and motels will be required to ensure that hearing aid compatible telephones are installed in (1) twenty percent of all guest rooms by April 1, 1997; (2) twenty-five percent of all guest rooms as of November 1, 1999; and (3) one hundred percent of all guest rooms by January 1, 2001 (for establishments with eighty or more guest rooms) or by January 1, 2004 (for establishments with fewer than eighty guest rooms).

4. Costs Of Compliance

60. Under Section 610(e), the Commission must consider the costs, as well as the benefits, of the proposed rules to all telephone users, including persons with and without hearing disabilities.¹⁴⁰ In the NPRM, we solicited comment on the costs to establishments of

¹³⁶ HACNRC Report at 28.

¹³⁷ Id.

¹³⁸ See Section 68.112(b)(6) in Appendix C.

¹³⁹ NPRM at para. 50 and page 49.

¹⁴⁰ 47 U.S.C. § 610 (e).

providing hearing aid compatible telephones.¹⁴¹ Apart from comments on the costs of complying with new volume control rules,¹⁴² there was little formal comment on the costs of compliance, although several hotel owners expressed some concern about cost in their informal comments.¹⁴³

61. We noted in the NPRM that in making its recommendations, the Committee weighed the costs and benefits to all telephone users, including to persons with and without hearing disabilities.¹⁴⁴ Representatives of large and small purchasers of telephones described to the Committee both the cost and effort that would be incurred as a result of the recommended regulations. Representatives of persons with hearing disabilities described the difficulties persons with hearing disabilities now experience when telephones are not hearing aid-compatible. Consumer representatives also described the increased access to telephone service such persons would receive if the Committee's proposed regulations were implemented. Representatives of equipment manufacturers and industry standards-setters reviewed for the Committee the cost and implementation issues posed by design, manufacture and distribution of equipment recommendations made by the Committee.

62. We conclude, as we did tentatively in the NPRM, that the costs involved will not be substantial and are significantly outweighed by the benefits to be achieved. The deadlines in the rules are intended to complement the telephone replacement cycle in the normal course of business. The Committee determined that the average useful life of a telephone in an establishment is seven years.¹⁴⁵ Since almost all telephones imported or manufactured for use in the United States have been hearing aid compatible since 1989, it is reasonable to conclude that the bulk of telephones in establishments are, by now, hearing aid compatible. The new rules give establishments at least an additional year, and in most cases several additional years, before compliance is required. The rebuttable presumption extends this grace period even further for workplaces. Hotels and motels which use telephones purchased January 1, 1985 through December 31, 1989 have until the year 2004 to make their guest room telephones one hundred percent hearing aid compatible.¹⁴⁶ Since these rules build on the normal, voluntary cycle of telephone replacement by establishments, we conclude that

¹⁴¹ NPRM at paras. 26, 46 and 53.

¹⁴² See para. 70, infra.

¹⁴³ See, e.g., January 2, 1996, letter from the California Hotel and Motel Association. See also para. 56, supra.

¹⁴⁴ NPRM at para. 20.

¹⁴⁵ HACNRC Report at 12; NPRM at para. 15.

¹⁴⁶ See Section 68.112(6)(C)(iii) in Appendix C.

the additional costs to establishments to comply will not be substantial, particularly in light of the many benefits users with hearing disabilities will receive from increased access to the telephone network.

C. VOLUME CONTROL

1. Background

63. In the NPRM, we proposed that all newly acquired and replacement telephones in workplaces, confined settings and hotels and motels be required to have volume control.¹⁴⁷ We noted that volume control would help the many hearing aid wearers whose hearing aids are not equipped with an electro-magnetic coil, and other individuals with hearing disabilities who do not use hearing aids.¹⁴⁸ To help ensure an adequate supply of volume control telephones, we proposed that, a year after adoption of our rules, all telephones manufactured or imported for use in the U.S. be required to have volume control.¹⁴⁹

2. Requiring Volume Control

a. Statutory Authority

(1) Comments

64. Three commenters contend that the Commission lacks statutory authority to require volume control.¹⁵⁰ They argue that volume control is not mentioned in the HAC Act, and that requiring volume control goes beyond the mandate of that Act.¹⁵¹ The Committee concluded that the statutory definition of hearing aid compatibility is sufficiently broad to include volume control.¹⁵²

(2) Discussion

65. We find that the Commission has authority under the HAC Act to require volume control. Section 610(a) gives the Commission a broad mandate to "establish such

¹⁴⁷ NPRM at para. 55.

¹⁴⁸ Id. at para. 60.

¹⁴⁹ Id. at para. 68.

¹⁵⁰ ABA Comments at 5; EEAC Comments at 9; FMI Comments at 3.

¹⁵¹ Id.

¹⁵² HACNRC Report at 14.

regulations as are necessary to ensure reasonable access to telephone service by persons with impaired hearing."¹⁵³ As discussed below, the volume control requirement is needed to ensure reasonable access to telephone service by many persons with hearing disabilities.¹⁵⁴ Furthermore, Section 610(b) states that the Commission shall require that all essential telephones, and all telephones manufactured or imported for use in the United States, provide an "internal means for effective use with hearing aids."¹⁵⁵ The HAC Act thus defines hearing aid compatibility generically and does not limit such compatibility to the provision of an electro-magnetic coil. Both the House and Senate Reports on the HAC Act state that technologies other than the electro-magnetic coil are contemplated in the definition of hearing aid compatibility, and the Senate Report specifically mentions amplification, or volume control, as an alternative technology.¹⁵⁶ Finally, Section 610(e) states that the Commission must ensure that its regulations "encourage the use of currently available technology."¹⁵⁷ Volume control is a currently available technology that allows telephones to be effectively used by persons with hearing aids, and by other persons with hearing impairment who do not use hearing aids.¹⁵⁸

b. Need for Volume Control Requirement

(1) Comments

66. Groups representing people with hearing loss strongly support the need for volume control requirements.¹⁵⁹ NAD/NCLD states that volume control would "make telephones accessible for a ... large portion of the American population who do not have full access at the present time."¹⁶⁰ SHHH states that volume control would benefit: (1) 4.6 million persons who wear hearing aids but who do not have telecoils, (2) 1.2 million persons who have significant hearing loss and thus need both a telecoil and volume control, and (3)

¹⁵³ 47 U.S.C. § 610(a).

¹⁵⁴ See paras. 63-66, *infra*.

¹⁵⁵ 47 U.S.C. § 610(b)(1).

¹⁵⁶ H.R. Rep. No. 674, 100th Cong., 2d Sess. 12 (1988); S. Rep. No. 391, 100th Cong., 2nd Sess. 10 (1988).

¹⁵⁷ 47 U.S.C. § 610(e).

¹⁵⁸ *Id.*

¹⁵⁹ See, SHHH Comments at 2, ASHA Comments at 2, PHSDS Comments at 1, HLA Comments at 2.

¹⁶⁰ NAD/NCLD Comments at 4.

22 million persons with hearing disabilities who do not use hearing aids.¹⁶¹ Other commenters state that the U.S. population is getting older, that by age of 65 more than sixty percent of people have significant hearing impairments, and that in the next 10 years, there will be 40 million Americans with hearing loss due to the aging of the population.¹⁶²

67. Thomson Consumer Electronics (TCE),¹⁶³ however, argues that a volume control manufacturing requirement is not justified because the market alone can provide an adequate supply of volume controlled telephones.¹⁶⁴ As evidence, TCE states that at least fifteen major manufacturers currently provide volume control telephones. In addition, ABA states that our proposed volume control rules duplicate its obligation under the ADA,¹⁶⁵ and some informal comments by hotel and motel owners and associations state that such entities currently have enough volume control telephones to satisfy demand and that volume control requirements for hotels and motels are unnecessary. The issues of ADA duplication and the supply of hearing aid compatible hotel and motel telephones are addressed at paras. 18 and 57, supra.

(2) Discussion

68. The HAC Act requires that telephones manufactured or imported for use in the United States be hearing aid compatible.¹⁶⁶ Since we are now including volume control within the definition of hearing aid compatible,¹⁶⁷ it follows that a requirement for manufacturing telephones with volume control must be set.

69. The record indicates that the proposed volume control requirements will make telephones more accessible for a significant portion of the population, including hearing aid wearers and others with hearing impairments. Furthermore, we are not persuaded that market forces alone would supply volume controlled telephones in sufficient quantity to satisfy the needs of all establishments required to provide such telephones under Sections 68.6 and

¹⁶¹ SHHH Comments at 3. SHHH estimates that there are 28 million Americans with hearing loss, and that, of these, 5.8 million use hearing aids, and that twenty percent of hearing aid users have hearing aids with telecoils. Id. at 2-3.

¹⁶² AGB Comments at 1; ASHA Comments at 5.

¹⁶³ TCE is a manufacturer of General Electric and RCA telephone products.

¹⁶⁴ TCE Comments at 1.

¹⁶⁵ ABA Comments at 5

¹⁶⁶ 47 U.S.C. § 610(b).

¹⁶⁷ See paras. 75-77 infra.

68.317.¹⁶⁸ The difficulties establishments experienced in attempting to comply with the regulations we adopted in 1992 were, in part, due to insufficient supply of complying equipment.¹⁶⁹ In addition, a manufacturing requirement is necessary for the same reason that Congress originally imposed a manufacturing requirement for hearing aid compatible telephones.¹⁷⁰ As stated in the Senate Report, "By imposing the responsibility for hearing aid compatibility at the time of manufacture rather than the time of installation, the law draws a clear line and places the burden for compliance on a smaller, and more organized, number of entities."¹⁷¹ A blanket manufacturing requirement also reduces confusion and increases the likelihood that a new or replaced telephone used in an emergency will have volume control.

c. Costs and Availability

(1) Background/Comments

70. Under Section 610(e), the Commission must consider the costs, as well as the benefits, of the proposed rules to all telephone users, including persons with and without hearing disabilities.¹⁷² In the NPRM, we solicited comment on the effect of the proposed rules on the costs of volume controlled telephones to manufacturers and on the price and availability of such telephones to consumers.¹⁷³

71. TCE states that under the proposed technical standard a volume control requirement would increase manufacturing costs between \$.05 and \$.10 per telephone unit.¹⁷⁴ TCE also states that the proposed volume control technical standard should be modified (see, infra, at para. 81), and that if that modification is adopted, the additional costs could range from \$.50 to up to \$1.00 per telephone.¹⁷⁵ TCE also states that there would be "millions of dollars" in additional start-up costs resulting from the need to redesign circuitry and cabinetry, modify current models in development, re-engineer molds and circuit boards, and to change

¹⁶⁸ See Sections 68.6 and 68.317, Appendix C.

¹⁶⁹ NPRM at para. 5.

¹⁷⁰ See 47 U.S.C. § 610(b)(1)(B).

¹⁷¹ Senate Report at 4.

¹⁷² 47 U.S.C. § 610 (e).

¹⁷³ NPRM at para. 70.

¹⁷⁴ TCE Comments at 4.

¹⁷⁵ TCE Comments at 4-5.

product literature and advertising.¹⁷⁶

72. Organizations representing persons with hearing disabilities note that telephones with volume control appear to be widely available and often cost no more at the retail level than telephones without volume control.¹⁷⁷ ACUTA contends that making volume control mandatory will lower the average cost of each volume-controlled telephone, because the costs will be distributed across all telephones manufactured in the U.S.¹⁷⁸

73. Informal comments by hotel and motel owners and associations argue that meeting the proposed volume control requirement would be costly. Most of these commenters erroneously believe that the proposed rules would require that in two or three years all hotel and motel telephones would have to have volume control. ABA, however, states that the record in the Committee Report and the NPRM on volume control is nonexistent or insufficient for the purposes of adopting regulations. ABA states that there is no history of manufacturing capability or the cost of volume control, and little in the record which discusses the current or future availability of volume control telephones.¹⁷⁹

(2) Discussion

74. In the NPRM we specifically requested comment on the potential added manufacturing and consumer costs that might be added due to a volume control requirement.¹⁸⁰ Based on a review of the record, we conclude that our proposed volume control rules will not impose significant additional costs on telephone users, manufacturers or the establishments required to provide volume control telephones. TCE was the only manufacturer to file comments on the cost issue. According to TCE, even with the minimum performance standard which we add to our proposed volume control standard (see, infra, at para. 83), volume control will only add an additional \$.50 to \$1.00 per unit to manufacturing costs. This amount appears to be generally affordable by the average consumer. Even when the start-up costs are added, we believe the average cost per unit will remain affordable, because those start-up costs will be averaged across millions of production units.¹⁸¹ In addition, commenters indicate that volume control telephones are already produced by several manufacturers and that they often cost no more at the retail level than telephones without

¹⁷⁶ Id. at 5.

¹⁷⁷ SHHH comments at 4. See also LHH Comments at 4.

¹⁷⁸ ACUTA Comments at 3.

¹⁷⁹ ABA Comments at 4; ITTA Comments at 6.

¹⁸⁰ NPRM at para. 70.

¹⁸¹ See ACUTA Comments at 3.

volume control. Finally, a principal manufacturers' representative, TIA, made no mention of additional costs in either its comments or its reply comments. We conclude that while cost is a factor to be considered, it is not such a major obstacle as to negate the benefits to be derived from requiring volume control.

75. Many of the comments on volume control costs from hotels and motels are based on the erroneous assumption that the commenters will be required to replace all telephones that do not have volume control with volume-controlled telephones. Under the proposed rules, however, an existing telephone that does not have volume control does not have to be replaced with a volume controlled telephone merely because the existing telephone does not have volume control. Volume control is required only for newly purchased telephones, or when an existing telephone is replaced for some reason other than the absence of volume control.¹⁸² Such a reason might be that the telephone does not have electro-magnetic coil compatibility, or because the telephone does not work properly and must be replaced. In such cases, the replacement telephone must have both electro-magnetic coil compatibility and volume control. See discussion of hotel and motel requirements at para. 55, *supra*. Finally, we conclude that as a result of the comments received in response to the NPRM, the record on volume control costs and availability is sufficient for purposes of adopting volume control regulations.

3. Inclusion in Definition of Hearing Aid Compatibility

a. Background/Comments

76. In the NPRM, we proposed that, for newly acquired and replacement telephones, the definition of hearing aid compatibility would be expanded to include both a volume control feature and electro-magnetic coil compatibility.¹⁸³ We also proposed that existing sections of our rules that refer to electro-magnetic coil compatibility as "hearing aid compatibility" be modified, for clarification, to state "as defined in Section 68.316."¹⁸⁴

77. In its comments, TIA states that the Commission's proposal to define "hearing aid compatibility" under some circumstances as both electro-magnetic coil compatibility and as volume control is confusing. Accordingly, TIA suggests that volume control be required pursuant to the general language of Section 610(a), rather than also including volume control in the definition of hearing aid compatibility.¹⁸⁵ That section states that "[t]he Commission shall establish such regulations as are necessary to ensure reasonable access to telephone

¹⁸² See Section 68.112(6)(A)(ii) in Appendix C; see also NPRM at para. 56.

¹⁸³ NPRM at para. 56.

¹⁸⁴ See NPRM at para. 78.

¹⁸⁵ TIA Comments at 5-6.

service by persons with impaired hearing."¹⁸⁶

b. Discussion

78. We conclude that the goals of the HAC Act would be best served if volume control is included within the definition of "hearing aid compatibility."¹⁸⁷ Under the HAC Act, "essential telephones" must be hearing aid compatible. Furthermore, hearing aid compatible is defined generically as an "internal means for effective use with hearing aids."¹⁸⁸ This definition is broadly written, to encompass many types of evolving technology, including volume control.¹⁸⁹

79. One type of "essential telephones" is "telephones provided for emergency use,"¹⁹⁰ and it is within the category of "telephones provided for emergency use" that telephones in workplaces, confined settings and hotels and motels fall.¹⁹¹ Volume control, as a type of hearing aid compatibility, properly falls within the scope of the HAC Act, and may be required in telephones "provided for emergency use." We agree with TIA that volume control also may be required because it falls within the language at 47 U.S. C. § 610(a).¹⁹²

80. For clarification, we also modify sections 64.607, 68.3, 68.4, 68.112(b)(4), 68.112(c), 68.224, and 68.316 by identifying hearing aid compatibility with the words "as defined in Section 68.316."

4. Transition Period

a. Background/Comments

81. In the NPRM, we proposed that manufacturers and importers be required to include volume control in all telephones made or imported for use in the United States one year after the adoption of the new rules. TCE, TIA and ACUTA suggest that a one-year

¹⁸⁶ 47 U.S.C. § 610(a).

¹⁸⁷ See Sections 68.112(b)(3)(C)(ii), 68.112(b)(5)(B)(ii), 68.112(b)(6)(A)(ii).

¹⁸⁸ 47 U.S.C § 610(b)(1).

¹⁸⁹ See para. 7, *supra*.

¹⁹⁰ 47 U.S.C. § 610(b)(4).

¹⁹¹ NPRM at para. 16.

¹⁹² "The Commission shall establish such regulations as are necessary to ensure reasonable access to telephone service by persons with impaired hearing."

transition period until volume control manufacturing is required is too brief. TIA states that a longer period is needed to redesign, test and evaluate products, to change printed materials, and to allow for an orderly depletion of existing non-volume-controlled telephones.¹⁹³ TIA surveyed some of its members, who stated that an appropriate preparation period could range from six months to three years. LHH, however, argues that a one year phase in period is "more than generous," considering that the technology is not only readily available, but also currently widely used.¹⁹⁴

b. Discussion

82. We conclude that two years would be a more appropriate transition time before manufacturers and importers are required to provide volume control telephones, because several commenters familiar with manufacturing procedures state that a one year period would be too brief a time to allow for equipment conversion and distribution changes. We note that a typical transition time for requiring the introduction of new technology under Part 68 is eighteen months.¹⁹⁵ We have decided to allow a slightly longer than average transition period in this case because we are requiring a significant change in the features for virtually all telephones that will be imported or manufactured for use in the United States. Manufacturers and importers will be required to make this change by November 1, 1998.¹⁹⁶

5. Technical Standard

a. Background

83. In the NPRM, we proposed a technical standard for volume control based on the standard used by the Architectural and Transportation Barriers Compliance Board (ATBCB) for public telephones.¹⁹⁷ The proposed standard applies a weighted average of loudness across the frequency range of a telephone's voice frequency band.¹⁹⁸ This standard has been shown to correlate well with human perception of the loudness of speech on a telephone connection.¹⁹⁹ The proposed standard uses Receive Objective Loudness Rating

¹⁹³ TIA Comments at 9.

¹⁹⁴ LHH Comments at 4.

¹⁹⁵ See, e.g. 47 C.F.R. §§ 68.2(e).

¹⁹⁶ See Section 68.6 in Appendix C.

¹⁹⁷ NPRM at para. 62.

¹⁹⁸ Id. at para. 63.

¹⁹⁹ Id. at para. 63.

(ROLR) to measure dB-gain, which is a numerical rating for loudness. This method of rating voice loudness has been used in the telecommunications industry for many years and the calculation procedures have been standardized.²⁰⁰

b. Feasibility of Volume Control Standard

(1) Comments

84. TCE states that the proposed standard needs a setting for a minimum performance level, because otherwise a manufacturer could technically meet the 12 dB to 18 dB gain requirements by adding a lower volume setting rather than offering capability for higher volume.²⁰¹ TIA agrees that a manufacturer could be in literal compliance with the gain requirement by lowering the volume setting, since the standard does not specify the nominal volume of sound that can emanate from a handset receiver. TIA states, however, that there is a voluntary industry standard for a minimum performance level that is working effectively, and that should manufacturers circumvent the spirit of the proposed standard, the Commission could take steps to remedy the situation at that time.²⁰²

85. TCE also contends that the network-supplied current through the telephone line may be insufficient to power terminal volume control units; that high gain units may impact network performance and require a waiver of return loss and/or acoustical feedback performance specifications; and that safety may be jeopardized because Peak Acoustical Power safety requirements²⁰³ may be more difficult to meet. In response, TIA asserts its engineering committees have had no problems with the implementation of the 12 dB - 18 dB gain requirement in telephones powered from the telephone line. TIA also states that a high volume waiver is not needed, because the proposed standard calls for meeting relevant parameters at nominal volume, not at high volume. TIA also states that manufacturers will continue to comply with Peak Acoustic Power safety requirements, even at higher volumes.²⁰⁴

²⁰⁰ Id.; IEEE (Institute of Electrical and Electronics Engineers) Standard 661-1979 (R1992), "Method for Determining Objective Loudness Ratings of Telephone Connections."

²⁰¹ TIA Reply Comments at 3-4.

²⁰² TIA Reply Comments at 3-4.

²⁰³ Peak Acoustical Power safety requirements are limits prescribed by industry on the loudness of sound that can be projected through a receiver, to protect the ear drum from, for example, the sudden sound of electrical pulses caused by lightning.

²⁰⁴ TIA Reply Comments at 4.

TIA also adds, in an ex parte communication,²⁰⁵ that the standard as proposed in the NPRM applies only to analog telephones, and that separate paragraphs are needed to cover digital Integrated Services Digital Network (ISDN) telephones.²⁰⁶

(2) Discussion

86. The technical standard we adopt applies a standard of increasing loudness, or volume, that we intend be applied to a baseline normal volume setting, or level of volume set in a receiver.²⁰⁷ As proposed in the NPRM, the standard technically could be met by lowering the baseline volume setting in the receiver, and then applying the standard to the lowered volume setting, so that the level of loudness would increase, but not to a degree sufficiently useful to a telephone user with hearing disabilities. To avoid this possibility, we modify the standard in the NPRM by adding a requirement that the telephone also shall comply with the upper and lower limits for ROLR given in ANSI/EIA-470-1987.²⁰⁸ To clarify the standard, we separate a portion of proposed Section 68.317(c) and make it into a new paragraph (f), and we make proposed subparagraph (d) into subparagraph (g).²⁰⁹ To include digital telephones²¹⁰ within our standard, we add new paragraphs Section 68.317(c)

²⁰⁵ TIA Ex Parte Communication, letter dated and filed April 30, 1996, from Roberta Breeden, TIA Director of Technical and Regulatory Affairs, to William Caton, Acting Secretary, Federal Communications Commission.

²⁰⁶ For a discussion of ISDN telephones, see In the Matter of Petition to Amend Part 68 of the Commission's Rules to Include Terminal Equipment Connected to Basic Rate Access Service Provided via Integrated Services Digital Network Access Technology, and In the Matter of Petition to Amend Part 68 of the Commission's Rules to Include Terminal Equipment Connected to Public Switch Digital Service, Report and Order, CC Docket No. 93-268, RM 7815, RM 6147, FCC 96-1, Adopted January 11, 1996, Released March 7, 1996 at para. 6. (ISDN R&O)

²⁰⁷ See Section 68.317 in Appendix C.

²⁰⁸ See Section 68.317(a) in Appendix C; see also TIA ex parte letter dated April 24, 1996, filed April 25, 1996, from Roberta Breeden, TIA Director of Technical and Regulatory Affairs, to William Caton, Acting Secretary of the Federal Communications Commission (April 24, 1996 Ex Parte). ANSI refers to the American National Standards Institute and EIA refers to the Electronic Industries Association. ANSI/EIA/TIA standards are available through the American National Standards Institute, Sales Department, 11 West 42nd Street, 13th Floor, New York, NY 10036, (212) 642-4900.

²⁰⁹ See April 24, 1996 Ex Parte.

²¹⁰ See ISDN R&O at para. 6.

and (d), and we incorporate by reference paragraph 4.3.2 of ANSI/EIA/TIA-579-1991.²¹¹ We also amend NPRM proposed Sections 68.317 (a), (b), (c) and (d) to reflect the coverage of digital as well as analog telephones.

87. TIA also states that the industry experience is that the standard works with line-powered units, and that a high volume waiver is not needed. We accept these statements of industry experience as reasonably predictive of what will occur when the volume control standard becomes part of our rules. We also accept TIA's statement that manufacturers will do what is necessary to meet the Peak Acoustic Power safety requirements.

c. Modifications to Technical Standard

(1) Comments

88. TIA points out that the proposed standard incorrectly describes Receive Objective Loudness Rating (ROLR) as a rating system for expressing all "receive response,"²¹² while ROLR is really only a measure of perceived loudness for a given input signal, which is a subset of the parameters that define receive response. To clarify the rule, TIA suggests adding the following footnote to subparagraph (a) of final rule Section 68.317:

Paragraph 4.1.2 of ANSI/EIA-470-A-1987 identifies several characteristics related to the receive response of a telephone. It is only the change in ROLR as a function of the volume control setting that is relevant to the specification of gain as required by this Section.

89. TIA also states that information requested in the NPRM to simulate the length of cable that will be used in measuring ROLR is still being developed by the industry. In the interim, TIA suggests that the Commission include in its final rules the information attached to its comments, namely a diagram of a loop simulator for 26 AWG cable.²¹³

²¹¹ See paragraph 4.3.2 of ANSI/EIA/TIA-579-1991 in Appendix C. Paragraph 4.3.2 of ANSI/EIA/TIA-579-1991 incorporates, by reference, two additional standards (IEEE Standard IEEE 661-1979; Section 7.4 of IEEE Standard IEEE 269-1992), and Section 7.4 of IEEE 269-1992 incorporates by reference Section 6.4.2 and Figures 12b and 13b of IEEE 269-1992. Section 6.4.2 refers to Figure 7 of IEEE 269-1992. We also include these standards and figures in Appendix C. IEEE standards are available at the American National Standards Institute (ANSI), Sales Department, 11 West 42nd Street, 13th Floor, New York, NY 10036, (212) 642-4900.

²¹² TIA Comments at 4, citing NPRM at paragraph 63 and note 101.

²¹³ See TIA Comments, Exhibit A.

90. In the NPRM, we proposed that the Commission delegate to the Chief, Common Carrier Bureau, the authority to issue a public notice of minor changes in the volume control standard. TIA supports this proposal, but adds that the referenced standards should not be restricted to ANSI standards.²¹⁴

(2) Discussion

91. We accept TIA's clarification of ROLR, and we adopt the suggested clarifying statement as a note to Section 68.317, rather than as a footnote. We will issue a final rule Section 68.117 that includes the suggested diagram (Loop Simulator for 26 AWG Cable) as part of the rule, as the Figure A referred to in Section 68.117(b).²¹⁵ In addition, we note that industry standards are periodically updated. To help ensure that our rules continue to reflect the current industry standard, we delegate to the Chief, Common Carrier Bureau, the authority to make minor changes, pursuant to the Administrative Procedure Act,²¹⁶ to the technical standards specified in Sections 68.316 and 68.317, in order to incorporate minor changes made in the relevant industry standards.

e. Miscellaneous Issues

(1) Location of Volume Control Mechanism

92. In the NPRM, we requested comment on whether the volume control mechanism could be located in the network as well as in the terminal equipment.²¹⁷ Several commenters objected to the possibility of locating the volume control mechanism in the telephone network. The United States Telephone Association (USTA) and USWest contend that network-based volume control is technically infeasible and that existing handset control technology is effective.²¹⁸ TIA argues that the best way to administer volume control under Part 68 is through regulating the terminal equipment that must be registered under Part 68, such as a telephone, or a PBX that includes the accompanying telephones as part of its registration.²¹⁹ Based on the comments received, we will not require at this time that a volume control mechanism be located in the network.

²¹⁴ TIA Comments at 7; NPRM at paras. 64 and 71.

²¹⁵ See Section 68.317 in Appendix C.

²¹⁶ 47 U.S.C. § 551-559.

²¹⁷ NPRM at para. 72.

²¹⁸ USTA Comments at 1; USWest Comments at 3.

²¹⁹ TIA Comments at 7. See also 47 U.S.C. § 68.300(b).

(2) Volume Control in Speaker Phones

93. ASHA urges that the volume control requirement apply not only to the sound emanating from the handset or headset, but also to sound emanating from open speakers in the terminal base, commonly known as "speaker phones."²²⁰ TIA, however, states that there is no industry standard for measuring the loudness of sound emanating from a speaker phone, and that such standards will not be available for some time.²²¹ We will not extend the volume control standard to "speaker phones" because the industry does not yet have the necessary standards for speaker phones. Furthermore, the focus of the Committee was on sound emanating from handsets and headsets, because it is sound from these portions of the terminal that relate most directly to the capabilities and efficacy of a hearing aid.

(3) Feedback

94. In the NPRM, we noted that some individuals with hearing aids encounter problems of "feedback" between their hearing aid and the telephone receiver.²²² Feedback occurs because both telephones and hearing aids contain microphones and amplifiers, and the electronic signals of these instruments can conflict and cause a characteristic feedback noise.²²³ LHH and HIA state that as long as the user can control the volume on a telephone, there should be little or no problem of feedback.²²⁴ Accordingly, we conclude that the addition of volume control will not create significant new problems of feedback between telephone receivers and hearing aids.

(4) Additional Proposed Modifications

95. HIA also proposes as "technical corrections" changing ROLR to RLR (Receive Loudness Rating) and substituting an international standard for the United States standard, ANSI/EIA 410-A-87.²²⁵ TIA asserts that the international standard places more emphasis on the low frequency portion of the telephone band, whereas the United States standard

²²⁰ ASHA Comments at 3.

²²¹ TIA Reply Comments at 2.

²²² NPRM at para. 66.

²²³ Id.

²²⁴ LHH Comments at 4; HIA Comments at 3.

²²⁵ HIA Comments at 4.

encourages equal levels of gain to be applied across the entire frequency range.²²⁶ We conclude that we should not rename a working industry-developed concept and acronym by shortening ROLR to RLR, nor should we adopt an international volume control standard that is less suitable than the United States standard for the goals of our volume control rules.

96. HIA requests that the Commission define the increase in the magnetic field that will result from the increased volume due to volume control. HIA notes that this increase will affect the operation of hearing aid telecoils and make the telecoils more effective.²²⁷ TIA argues that the Commission should not attempt to quantify this magnetic field increase at this time because substantial additional work would need to be done by the appropriate industry standards committees to express the magnetic field requirements in a manner consistent with the standards of ROLR.²²⁸ We find that it is not essential to our rules to quantify the magnetic field increase at this time, and that we should not seek to quantify this increase until the industry standards committees have completed their work. We do encourage, however, continued dialogue between the telecommunications and hearing impaired equipment industries toward the development of voluntary standards for the increase in the magnetic field when volume is increased.

(5) Obsolescence of Current Volume Control Telephones

97. One commenter expressed concern that establishing a volume control technical standard would render current volume control telephones obsolete.²²⁹ We acknowledge that the volume control mechanism in some existing volume controlled telephones will not be consistent with the technical standard we are adopting in this proceeding.²³⁰ These telephones, therefore, cannot be used as replacement telephones. Telephones that do not meet the new standard cannot be used as replacement telephones where a complying volume controlled telephone is required. We note, however, that many existing volume controlled telephones will be in compliance with this standard.

D. EQUIPMENT LABELING

1. Background

98. Pursuant to Section 68.300(b) telephone equipment manufacturers are required

²²⁶ TIA Reply Comments at 5-6.

²²⁷ HIA Comments at 3.

²²⁸ TIA Reply Comments at 5.

²²⁹ California Hotel and Motel Association Comments at 1.

²³⁰ See Section 68.317 in Appendix C.

to stamp equipment with either a date of manufacture or a serial number.²³¹ In the NPRM we proposed that manufacturers be required to stamp registered terminal equipment and registered protective circuitry with a date of manufacture.²³² We tentatively concluded that this change would make it easier for an establishment to determine whether its telephones are hearing aid compatible, because virtually all wireline telephones manufactured or imported for use in the United States after August 16, 1989 are required to be compatible with hearing aid telecoils.²³³ In addition, users would be able to determine if a telephone has volume control by the date of manufacture, once a volume control date-of-manufacture requirement is adopted. We did solicit comment, however, on whether, as an alternative, we should require manufacturers to stamp or emboss a symbol or set of letters, such as "HAC," on terminal equipment, in addition to, or as an alternative to, the date of manufacture.²³⁴

2. Comments

99. Several organizations representing persons with hearing disabilities comment that letters, a sign or a symbol would be more useful to the informed user than a date of manufacture because most telephone consumers are not aware of the significance of August 16, 1989.²³⁵ Most commenters suggest using the letters "HAC" or "HAC/VC." Pursuant to the Paperwork Reduction Act,²³⁶ The Office of Management and Budget (OMB) disapproved the Commission's application for permission to change Section 68.300(b), because labeling equipment with dates would be meaningless to installers or users. Instead, OMB suggests the Commission could require labeling that would inform a user that the telephone is hearing aid compatible and equipped with volume control.

100. In its comments, TIA favors the use of date of manufacture over the use of signs or symbols. The use of the date has been an option in the Commission's Part 68 rules for years, TIA states, and manufacturers are familiar with using a date. TIA contends that stamping a telephone with the letters "HAC" might imply to the uninformed user that telephones without the "HAC" stamp are not hearing aid compatible, when, in fact, the vast majority of telephones in use are hearing aid compatible, because they were imported or manufactured after August 16, 1989.

²³¹ 47 C.F.R. § 68.300(b)(3).

²³² NPRM at paras. 29 and 73.

²³³ 47 U.S.C. § 610(b)(1)(B).

²³⁴ NPRM at para. 74.

²³⁵ See e.g. LHH Comments at 5; TDI Comments at 2; NAD/NCLD Comments at 5; SHHH Comments at 6.

²³⁶ Paperwork Reduction Act of 1995, Pub. L. 104-13.

3. Discussion

101. We concur with the statements of OMB and organizations representing persons with hearing disabilities that an easily recognizable symbol or set of letters would be more useful to the average telephone user than a date of manufacture. The average telephone user is not likely to know the significance of August 16, 1989, for electro-magnetic coil compatibility, and might more easily understand a set of letters or a recognizable sign or symbol.

102. In light of the record, we amend our proposal to require telephones with electro-magnetic coil compatibility to be stamped with the letters "HAC."²³⁷ We understand this is a commonly used term in organizations representing persons with hearing disabilities, and can be understood by the general public. We give manufacturers and importers six months, until April 1, 1997, before they are required to comply with this requirement.²³⁸ We also conclude that a separate set of letters is not needed to designate the presence of a volume control feature, because such a feature is generally apparent from the volume controls on a telephone. We will designate in our final rule that the letters "HAC" will indicate hearing aid compatibility as defined by Section 68.316 of our rules, i.e., electro-magnetic coil compatibility. We also leave unchanged Section 68.300(b)(3), which requires manufacturers to attach either a date of manufacture or a serial number.²³⁹ To the extent manufacturers do stamp equipment with the date of manufacture, and to the extent users and installers are familiar with the key dates for hearing aid compatibility and volume control, we conclude that providing the date of manufacture will be meaningful to installers and users.

E. CONSUMER EDUCATION

a. Background/Comments

103. In the NPRM, we sought comment on certain recommendations of the Negotiated Rulemaking Committee concerning consumer education.²⁴⁰ The Committee recommended that the Commission (1) issue a press release, hold a press conference about the Committee's Report and distribute the Report electronically; (2) develop a consumer information package about the hearing aid compatibility rules; (3) encourage the development

²³⁷ See Section 68.300(c) in Appendix C. We create a new subsection (c) so that the lettering requirement applies only to telephones, and not to the registered protective circuitry included in Section 68.300(b).

²³⁸ Id.

²³⁹ See 47 C.F.R. § 68.300(b)(3).

²⁴⁰ NPRM at para. 75.

of information that could be included with hearing aid packaging; and (4) encourage voluntary public signage to identify the location of hearing aid compatible telephones in the workplace.²⁴¹ We further noted in the NPRM that we had already completed the first recommendation of the Committee, namely to distribute the Committee Report electronically, to hold a press conference, and issue a press release regarding that Report.²⁴²

104. Numerous commenters strongly encourage the Commission to adopt consumer education initiatives.²⁴³ Some commenters suggest that the Commission should develop information packages for businesses and consumers.²⁴⁴ SHHH suggests that other initiatives such as a video on telecoils and Commission articles in consumer publications be considered.²⁴⁵ SHHH and LHH provide a list of items which can be included in hearing aid packaging, such as a description of the telecoil option, an overview of the HAC Act and Commission rules, and instructions on how to use telecoils.²⁴⁶ HIA, a representative of hearing aid manufacturers, states that individual hearing aid manufacturers should be allowed to develop package inserts relevant to their products.²⁴⁷

b. Discussion

105. We recognize the importance of public education about hearing aid compatibility. Accordingly, we will issue a press release on this order, and make this order available electronically.²⁴⁸ Within six months of the adoption of this Report and Order, we will (1) develop "fact sheets" for consumers and businesses about hearing aid compatibility; (2) develop a "model" package insert for hearing aid manufacturers; and (3) coordinate with other government agencies and with private organizations in the development and dissemination of these materials. We agree with HIA, however, that the development of package inserts should be left largely to the individual hearing aid manufacturers, and we note that the use of any "model" developed by the Commission is not mandatory, but rather is

²⁴¹ Id.

²⁴² Id. at para. 76.

²⁴³ ACUTA Comments at 4; ITTA Comments at 6; LHH Comments at 5; NAD/NCLD Comments at 5-6; SHHH Comments at 7-8.

²⁴⁴ See e.g. ACUTA Comments at 4.

²⁴⁵ SHHH Comments at 7-8.

²⁴⁶ SHHH Comments at 6; League Comments at 5:

²⁴⁷ HIA Comments at 4.

²⁴⁸ The Commission's Internet Home Page is currently located at <http://www.fcc.gov>.

provided for purposes of establishing a guideline. These efforts will give industry, government, individuals who have hearing disabilities and the general public ample notice of the effect of these rules on the rights and responsibilities of all parties concerned.

IV. CONCLUSION

106. We believe that the rules adopted in this Report and Order will significantly increase access to the telephone network for individuals with hearing disabilities, at minimal cost to workplaces, confined settings, hotels and motels and manufacturers. The rules represent the culmination of an extraordinary effort among organizations representing government, business, industry and individuals with hearing disabilities on the Committee. The efforts of this Committee produced consensus recommendations for Commission rules that strike a balance among the interests of the various interested parties. As a result of the Committee's efforts, the rulemaking process was streamlined: the Committee reached full consensus on all issues in record time, the number of comments in the record was greatly reduced and the public interest has been served.

V. REGULATORY FLEXIBILITY ACT ANALYSIS

107. Final Regulatory Analysis: Pursuant to the Regulatory Flexibility Act of 1980, 5 U.S.C. Section 601, et seq., the Commission's final analysis in this Report and Order is attached as Appendix B.

VI. ORDERING CLAUSES

108. Accordingly, IT IS ORDERED that, pursuant to Sections 1, 4, 201-205, 218, 220 and 610 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 151, 154, 201-205, 218, 220, and 610, and 5 U.S.C. §§ 552 and 553, this Report and Order IS ADOPTED, and Parts 64 and 68 of the Commission's Rules ARE AMENDED as set forth in the attached Appendix C.

109. IT IS FURTHER ORDERED that the rule amendments set forth in Appendix C SHALL BE EFFECTIVE seventy days after publication in the Federal Register.

110. IT IS FURTHER ORDERED that the Emergency Request to Reinstate Enforcement of the Hearing Aid Compatibility Rules, dated May 12, 1993, by Alexander Graham Bell Association for the Deaf, et al, IS DISMISSED.

111. IT IS FURTHER ORDERED that, pursuant to Section 5(c)(1) of the Communications Act of 1934, as amended, 47 U.S.C. § 155(c)(1), authority is delegated to the Chief, Common Carrier Bureau, to make minor changes, pursuant to the Administrative Procedure Act procedures, in the technical standards specified in Sections 68.316 and 68.317 of the rules, in order to incorporate minor changes made in the relevant industry standards.

FEDERAL COMMUNICATIONS COMMISSION

William F. Caton
Acting Secretary

APPENDIX A: LIST OF PARTIES

I. Parties Filing Comments (January 29, 1996)*

Aeronautical Radio, Inc. (ARINC)
Alexander Graham Bell Association for the Deaf (AGB)
American Bankers Association (ABA)
American Health Care Association (AHCA)
The American Speech-Language-Hearing Association (ASHA)
The Association of College and University Telecommunications Administrators, Inc. (ACUTA)
Care Providers of Minnesota (CPM)
Center for the Deaf and Hard of Hearing (CDHH)
Chicago Hearing Society (CHS)
Communications Workers of America (CWA)
Credit Union National Association, Inc.(CUNA)
Equal Employment Advisory Council (EEAC)
Food Marketing Institute (FMI)
General Services Administration (GSA)
HANDS Organization (HANDS)
Hearing Industries Association (HIA)
IMPACT, Inc., CIL (Center for Independent Living)
The Information Technology and Telecommunications Association (ITTA)
League for the Hard of Hearing (LHH)
The National Association of the Deaf and the National Center for Law and Deafness (NAD/NCLD)
National Association of Manufacturers (NAM)
National Federation of Independent Business (NFIB)
Newspaper Association of America (NAA)
Pittsburgh Hearing, Speech & Deaf Services, Inc (PHSDS).
Self Help for Hard of Hearing People, Inc. (SHHH)
Telecommunications for the Deaf, Inc. (TID)
Telecommunications Industry Association User Premises Equipment Division (TIA); (Errata filed on February 27, 1996)
Thomson Consumer Electronics (TCE)
Ms. Bea Tusiani
United States Telephone Association (USTA)
U S WEST, Inc. (USWest)

* Forty-five informal comment letters also were filed. Forty-two of the letters were from hotel and motel associations or individual hotels and motels.

II. Parties Filing Reply Comments (February 29, 1996)

American Public Communications Council (APCC)

Communications Workers of America (CWA)

General Services Administration (GSA)

Information Technology and Telecommunications Association (ITTA)

National Association of the Deaf, et al. (NAD)

Telecommunications Industry Association (TIA)

APPENDIX B: FINAL REGULATORY FLEXIBILITY ANALYSIS

1. Final Regulatory Analysis: As required by Section 603 of the Regulatory Flexibility Act, 5 U.S.C. § 603 (RFA), an Initial Regulatory Flexibility Analysis (IRFA) was incorporated in the Notice of Proposed Rulemaking (NPRM).²⁴⁹ The Commission sought written public comments on the proposals in the NPRM, including on the IRFA. The Commission's Final Regulatory Flexibility Analysis (FRFA)²⁵⁰ in this Report and Order is as follows:

a. Need for, and Objectives of, This action: This Report and Order amends the Commission's rules to require that eventually all wireline telephones in workplaces, confined settings and hotels and motels be hearing aid compatible and have volume control. The Report and Order also requires that as of November 1, 1998 all wireline telephones manufactured or imported for use in the United States must have volume control. These actions are needed to provide greater access to the telephone network by persons with hearing disabilities, pursuant to the requirements of the Hearing Aid Compatibility Act of 1988 (HAC Act).²⁵¹ The HAC Act directs the Commission to take affirmative and specific steps to increase such access.²⁵² The objectives of these rules are to provide the needed greater access, while at the same time balancing the needs of establishments that must provide the hearing aid compatible and volume control telephones.

b. Summary of Significant Issues Raised by the Public Comments In Response to the Initial Regulatory Flexibility Analysis: There were no comments submitted in direct response to the Regulatory Flexibility Analysis in the NPRM. In general comments on the NPRM, however, a number of commenters raised issues that might affect small entities. Several commenters stated that the Commission's proposed rules would duplicate the provisions of the Americans With Disabilities Act of 1990 (ADA), or exceed the Commission's authority under the HAC Act, thus unnecessarily burdening establishments.²⁵³ A number of hotel and motel owners said the costs to replace telephones would be

²⁴⁹ Access to Telecommunications Equipment and Services by Persons With Disabilities, Notice of Proposed Rulemaking, 11 FCC Rcd 4338 (1995).

²⁵⁰ Our final analysis conforms to the RFA, as amended by the Contract With America Advancement Act of 1996, P.L. No. 104-121, 110 Stat. 847 (1996) (CWAAA). Subtitle II of CWAAA is "The Small Business Regulatory Enforcement Fairness Act of 1996" (SBREFA).

²⁵¹ 47 U.S.C. § 610(a).

²⁵² See 47 U.S.C. § 710(a), (b).

²⁵³ See paras. 7-22, supra.

burdensome.²⁵⁴ One manufacturer said the volume control manufacturing requirement could cost "millions of dollars" in start-up costs.²⁵⁵ An association of manufacturers stated that the proposed one-year phase-in of the volume control manufacturing requirement was too short.²⁵⁶ Several organizations representing persons with hearing disabilities said that stamping the letters "HAC" on a telephone would be more informative than stamping the date of manufacture.²⁵⁷

c. Description and Estimate of Number of Small Businesses to Which Rules Will Apply:

(1) The RFA generally defines the term "small business" as having the same meaning as the term "small business concern" under the Small Business Act, 15 U.S.C. § 632. A small business concern is one which (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the Small Business Administration (SBA). *Id.* The RFA SBREFA provisions also apply to nonprofit organizations and to governmental organizations.

(2) The rules in this Report and Order apply to four industry categories: (a) workplaces; (b) confined settings, such as hospitals and nursing homes; (c) hotels and motels; and (d) importers and manufacturers of telephones for use in the United States. There is little overlap among these categories because the Commission's workplace rules affect workplace noncommon areas, while the rules that apply to confined settings and hotels and motels affect other than the workplaces of those establishments. Telephone manufacturers would be affected as workplaces, but separately affected by the requirement to affix the letters "HAC" to telephones and by the volume control manufacturing requirement. The determination of whether or not an entity within these industry groups is small is made by the Small Business Administration (SBA). These standards also apply in determining whether an entity is a small business for purposes of the RFA.

(3) Workplaces: Workplaces encompass establishments for profit and nonprofit, plus local, state and federal governmental entities. Establishments with fewer than fifteen employees generally would be excluded, because they are exempt from the

²⁵⁴ See para. 56, supra.

²⁵⁵ See paras. 70-75, supra.

²⁵⁶ See para. 81, supra.

²⁵⁷ See paras. 98-102, supra.

Commission's new rules,²⁵⁸ except for the work station requirement.²⁵⁹ SBA guidelines²⁶⁰ to the SBREFA state that about 99.7 percent of all firms are small and have fewer than 500 employees and less than \$25 million in sales or assets. There are approximately 6.3 million establishments in the SBA database. We estimate that our rules would affect fewer than 6.3 million establishments, because our rules exclude establishments with fewer than fifteen employees. However, we have not been able to determine what portion of the 6.3 million establishments have fewer than fifteen employees. The SBA data base does include nonprofit establishments, but it does not include governmental entities. SBREFA requires us to estimate the number of such entities with populations of less than 50,000 that would be affected by our new rules.²⁶¹ There are 85,006 governmental entities in the nation.²⁶² This number includes such entities as states, counties, cities, utility districts and school districts. There are no figures available on what portion of this number has populations of fewer than 50,000. However, this number includes 38,978 counties, cities and towns, and of those, 37,566, or 96 percent, have populations of fewer than 50,000.²⁶³ The Census Bureau estimates that this ratio is approximately accurate for all governmental entities. Thus, of the 85,006 governmental entities, we estimate that 96 percent, or 81,600, are small entities that would be affected by our rules.

(4) Confined Settings: According to the SBA's regulations, nursing homes and hospitals must have annual gross receipts of \$5 million or less in order to qualify as a small business concern. 13 C.F.R. §121.201. There are approximately 11,471 nursing care firms in the nation, of which 7,953 have annual gross receipts of \$5 million or less.²⁶⁴ There are approximately 3,856 hospital firms in the nation, of which 294 have gross receipts of \$5 million or less. Thus, the approximate number of small confined setting entities to which the Commission's new rules will apply is 8,247.

²⁵⁸ The Commission adopted the ADA cutoff of exempting establishments with fewer than fifteen employees. See para. 27, supra; NPRM at para. 25.

²⁵⁹ See para. 31, supra.

²⁶⁰ A Guide to the Regulatory Flexibility Act, U.S. Small Business Administration, Washington D.C., May, 1996, at page 14.

²⁶¹ RFA at Section 601(5).

²⁶² 1992 Census of Governments, Bureau of the Census, U.S. Department of Commerce.

²⁶³ Id.

²⁶⁴ See Small Business Administration Tabulation File, SBA Size Standards Table 2C, January 23, 1996, SBA, Standard Industrial Code (SIC) categories 8050 (Nursing and Personal Care Facilities) and 8060 (Hospitals). (SBA Tabulation File)

(5) Hotels and Motels: According to the SBA's regulations, hotels and motels must have annual gross receipts of \$5 million or less in order to qualify as a small business concern. 13 C.F.R. §121.201. There are approximately 34,671 hotel and motel firms in the United States. Of those, approximately 31,382 have gross receipts of \$5 million or less.²⁶⁵

(6) Telephone Manufacturers and Importers: According to the SBA's regulations, telephone apparatus firms must have 1,000 or fewer employees in order to qualify as a small business concern. 13 C.F.R. §121.201.²⁶⁶ There are approximately 456 telephone apparatus firms in the nation.²⁶⁷ Figures are not available on how many of these firms have 1,000 or fewer employees, but 401 of the firms have 500 or fewer employees.²⁶⁸ It is probable that the great bulk of the 456 firms have 1,000 or fewer employees, and would be classified as small entities. In addition to telephone apparatus firms, there are approximately 12,654 wholesale electronic parts and equipment firms in the nation. Many of these firms serve as importers of telephones.²⁶⁹ According to the SBA's regulations, wholesale electronic parts and equipment firms must have 100 or fewer employees in order to qualify as a small business entity. 13 C.F.R. §121.201. Of the 12,654 firms, 12,161 have fewer than 100 employees, and would be classified as small entities.²⁷⁰

d. Description of Projected Reporting, Recordkeeping and Other Compliance Requirements of the Rules:

(1) Reporting and Recordkeeping: This Report and Order involves three reporting requirements. First, as of April 1, 1997, importers and manufacturers of telephones for use in the United States must stamp their telephones with the letters "HAC."²⁷¹ The potential respondents to this requirement are importers and manufactures of telephones for use

²⁶⁵ SBA Tabulation File, SIC category 7010.

²⁶⁶ No foreign entity submitted comments on the NPRM, nor have we been able to obtain data on foreign telephone equipment manufacturers from other sources. The SBA does not compile data on foreign manufacturers.

²⁶⁷ U.S. Dept. of Commerce, 1992 Census of Transportation, Communications and Utilities (issued May 1995), SIC category 3661.

²⁶⁸ Id.

²⁶⁹ U.S. Dept. of Commerce, 1992 Census of Transportation, Communications and Utilities (issued May 1995), SIC category 5065.

²⁷⁰ Id.

²⁷¹ See Section 68.300, Appendix C; see also paras. 98-102, supra.

in the United States. Second, until the rules for all workplace telephones go into effect, employers are required to designate certain hearing aid compatible telephones for emergency use.²⁷² The potential respondents to this requirement are owners of workplaces with fifteen or more employees. Third, a Commission rule regarding packaging is amended to clarify that the type of hearing aid compatibility referred to is electro-magnetic coil compatibility.²⁷³ The potential respondents to this requirement are importers and manufacturers of telephones for use in the United States.

(2) Other Compliance Requirements:

(a) The rules adopted in this Report and Order require that as of certain dates, owners of workplaces, confined settings and hotels and motels provide telephones that have electro-magnetic coil hearing aid compatibility and volume control.²⁷⁴ These requirements will affect owners of workplaces, confined settings, and hotels and motels.

(b) The rules also require importers and manufacturers of telephones for use in the United States to provide telephones with volume control, beginning November 1, 1998.²⁷⁵ These rules would affect small as well as large domestic manufacturers of telephones.

e. Commission Efforts to Learn Of, and Respond To, the Views of Small Business: In 1992 the Commission adopted rules requiring hearing aid compatible telephones in workplaces, confined settings and hotels and motels.²⁷⁶ As the time to implement the rules approached, businesses, including small businesses, stated that they were having difficulty implementing the rules.²⁷⁷ In response, the Commission suspended the rules in 1993.²⁷⁸ Subsequently, the Commission formed the nineteen-member Hearing Aid Compatibility Negotiated Rulemaking Committee. Among the Committee's membership were representatives of small business. Both the hotel and motel representatives (American Hotel and Motel Association) and the confined setting representatives (American Health Care Association) have many small members. In addition, the Tele-Communications Association

²⁷² See Section 68.112(b)(3)(E) in Appendix C; see also paras. 42-46, *supra*.

²⁷³ See Section 68.224 in Appendix C.

²⁷⁴ See Section 68.112(b) in Appendix C.

²⁷⁵ See Section 68.6 in Appendix C; see also para. 82, *supra*.

²⁷⁶ See paras. 2-6, *supra*; NPRM at paras. 4-9.

²⁷⁷ See NPRM at para. 5.

²⁷⁸ *Id.*

(now known as The Information Technology and Telecommunications Association, or ITTA),²⁷⁹ a broadly based end-users group, was a member. ITTA has approximately 1,000 members, including small entities as members.²⁸⁰

f. Commission Efforts to Minimize Burdens on Small Business:

(1) In applying the new rules, the Commission has sought to minimize any disproportionate burden on small entities. The workplace requirements, for example, generally exempt workplaces of fewer than fifteen employees. The Commission provided this exemption because small employers have smaller budgets, which can make installation of new telephones disproportionately more burdensome for those employers.²⁸¹ This is the same coverage cutoff standard used in the ADA.²⁸² In calculating the number of "employees" for purposes of compliance, the total employment force of an establishment, not the number of employees an employer may have at a particular site, is the determining factor. This distinction emphasizes that it is the overall size of the entity, not the circumstance of the deployment of its employees, that determines the impact of the Commission's requirements.²⁸³

(2) The Commission also took into account the needs of small entities in setting the compliance deadlines for workplaces. The Committee determined that the average useful life of a workplace telephone is seven years. Almost all telephones manufactured or imported for use in the United States since August 16, 1989 have had to be hearing aid compatible. Thus, at the present time, any workplace telephone is most likely to be hearing aid compatible. As a margin of flexibility, however, the Commission set the workplace compliance deadline for November 1, 2005 for telephones purchased between January 1, 1985 through December 31, 1989, and November 1, 2000 for all other telephones.²⁸⁴ Even after those dates, small entities are allowed to exercise the rebuttable presumption, so that they do not have to test and replace their telephones.²⁸⁵ Before those dates, workplaces may use

²⁷⁹ See para. 3, supra.

²⁸⁰ Id.

²⁸¹ See NPRM at para. 25.

²⁸² Id.

²⁸³ See para. 27, supra.

²⁸⁴ See para. 24, supra.

²⁸⁵ See Final Rules, Appendix C; see also para. 35, supra. The presumption is that beginning January 1, 2000 (or 2005, depending on when the telephones were purchased), an employer may presume its workplace telephones are hearing aid compatible. The presumption can be rebutted on a telephone-by-telephone basis by any person legitimately on the workplace premises who

existing stored telephone inventories as replacements, subject to a rebuttable presumption.²⁸⁶ Thus, the stored inventories of small entities are not rendered obsolete.

(3) The requirements for confined settings and hotels and motels also make distinctions in the size of establishment. Smaller establishments are given more time to comply. Confined setting establishments with fewer than fifty beds are given an extra year, until November 1, 1998, to comply, and hotels and motels with fewer than eighty rooms also are given an extra year, until November 1, 1999, to comply.²⁸⁷

(4) The Commission also took into account the needs of small entities in the terms of the volume control manufacturing requirement. The Commission had proposed, in the NPRM, a one-year deadline for this requirement, but after receiving comment from organizations representing large and small manufacturers, the Commission extended the period to two-years, until November 1, 1998, before compliance with the volume control rule is required. Similarly, the requirement that manufacturers affix the letters "HAC" to new telephones does not go into effect upon the effective date of the new rules, but six months later, on April 1, 1997.²⁸⁸ Current small manufacturer telephone inventories are not affected by this requirement.

(5) Under Section 610(e) of the HAC Act, the Commission must consider the costs, as well as the benefits, of the proposed rules to all telephone users, including persons with and without hearing disabilities.²⁸⁹ In the NPRM, the Commission solicited comment on the costs to establishments of providing volume control and hearing aid compatible telephones.²⁹⁰ After reviewing the comments, the Commission concluded that the new rules will not impose significant additional costs on telephone users, manufacturers or establishments, and that any costs are significantly outweighed by the benefits to be achieved.²⁹¹

g. Commission Efforts to Maximize Benefits: Small entities will be among the

makes an identification of a particular telephone as not being hearing aid compatible. Id.

²⁸⁶ See Section 68.112(b)(1)(F) in Appendix C.

²⁸⁷ Id.

²⁸⁸ Id.

²⁸⁹ 47 U.S.C. § 610 (e).

²⁹⁰ NPRM at paras. 26, 46 and 53.

²⁹¹ See paras. 62 and 74-75, supra.

beneficiaries of the Commission's new rules. Under the new rules, telephones in workplaces, confined settings and hotels and motels will be more accessible to persons with hearing disabilities. These changes may lead to new business for hotels and motels and confined settings, and workplaces may be able to hire better employees, since the pool of potential employees will be widened to include persons with hearing disabilities. In addition, the level of public safety will increase in all three settings, thereby benefitting both the business setting and the public at large. Telephones also will be easier to identify by installers, many of whom will be small entities, as hearing aid compatible, once they are stamped "HAC." Finally, the volume control requirement probably will increase the consumer demand for volume control telephones, benefitting large and small manufacturers alike.

h. Significant Alternatives Minimizing Impact on Small Entities That Were Rejected:

(1) The Commission considered not including within the purview of "telephones provided for emergency use" telephones in workplace non-common areas, telephones in confined settings and telephones in hotels and motels. However, the Commission concluded that given the nature of such settings, and the needs of persons in such settings, telephones in workplace noncommon areas, confined settings and hotels and motels should be considered telephones provided for emergency use. The Commission noted that persons with hearing disabilities are particularly vulnerable in confined settings and hotels and motels because the persons may be unfamiliar with the settings and isolated in the event of an emergency.

(2) Similarly, the Commission considered not adding a requirement for volume control, but concluded that volume control should be required. The HAC Act defines telephone hearing aid compatibility as "an internal means for effective use with hearing aids,"²⁹² and the legislative history cites amplification, or volume control, as one such type of internal means.²⁹³ The Commission is obliged under the HAC Act to encourage the use of currently available technology in fulfilling the act's mandates.²⁹⁴ Through the conclusions of its advisory committee, the Hearing Aid Compatibility Negotiated Rulemaking Committee, the Commission determined that volume control is a currently available technology that would help give many persons with hearing disabilities increased access to the telephone network.²⁹⁵

²⁹² 47 U.S.C. § 610 (b)(1)(b).

²⁹³ See para. 65, *supra*.

²⁹⁴ 47 U.S.C. § 610(e).

²⁹⁵ See paras. 66-69, *supra*.

i. Summary of Paperwork, Recordkeeping, and Other Compliance Requirements for Wireline Telephones:

(a) Paperwork requirements: As of April 1, 1997, importers and manufacturers of telephones for use in the United States must stamp their telephones with the letters "HAC." Until the rules for all workplace telephones go into effect, employers are required to designate certain hearing aid compatible telephones for emergency use. A Commission rule regarding packaging is amended to clarify that the type of hearing aid compatibility referred to is electro-magnetic coil compatibility.

(b) Recordkeeping requirements: NONE.

(c) Other compliance requirements:²⁹⁶

As of the effective date of this order, telephones, including headsets, made available to an employee with a hearing disability for use by that employee in his or her employment duty shall be hearing aid compatible;

As of the effective date of this order, newly purchased or replacement telephones in workplaces, confined settings and hotels and motels must be hearing aid compatible. In workplaces, if the replacement telephone is from inventory existing before the effective date of this order, any person may make a bona fide request that such telephone be hearing aid compatible, and, after November 1, 1998, have volume control.

As of the effective date of this order, if a hotel or motel room is renovated or newly constructed, or the telephone in a hotel or motel room is replaced or substantially, internally repaired, the telephone must be hearing aid compatible.

As of the effective date of this order, and until the applicable workplace dates of January 1, 2000 or 2005, workplaces of fifteen or more employees must provide and designate telephones for emergency use by employees with hearing disabilities by providing a hearing aid compatible telephone within a reasonable and accessible distance for an individual searching for a telephone from any point in the workplace, or by providing hearing aid compatible wireless telephones.

As of April 1, 1997, the telephones in at least twenty percent of hotel and motel guest rooms must be hearing aid compatible.

As of November 1, 1997 telephones (except telephones purchased and

²⁹⁶ This summary represents only a general statement of requirements for establishments, manufacturers and importers. For a complete and particular statement, see the Final Rules in Appendix C.

maintained by a resident for use in that resident's room, and except where a confined establishment has an alternate means of signalling life-threatening or emergency situations that is available, working and monitored) in confined settings with fifty or more beds must be hearing aid compatible;

As of November 1, 1998, telephones (except telephones purchased and maintained by a resident for use in that resident's room, and except where a confined establishment has an alternate means of signalling life-threatening or emergency situations that is available, working and monitored) in confined settings with fewer than fifty beds must be hearing aid compatible;

As of November 1, 1998, the telephones in hotels and motels with eighty or more guest rooms must be hearing aid compatible;

As of November 1, 1998 telephones for use in the United States provided by importers and manufacturers must have volume control, and newly purchased and replacement telephones in workplaces, confined settings and hotels and motels must have volume control. In addition, in hotels and motels, where a hotel or motel room is renovated or newly constructed, or the telephone is replaced or substantially, internally repaired, the telephone in that room must have volume control.

As of November 1, 1999, the telephones in hotels and motels with fewer than eighty guest rooms must be hearing aid compatible.

As of November 1, 1999, where a hotel or motel uses telephones purchased during the period January 1, 1985 through December 31, 1989, the telephones in at least twenty-five percent of hotel and motel guest rooms must be hearing aid compatible.

As of January 1, 2000, non-common area telephones (except headsets, and except for telephones purchased between January 1, 1985 and December 31, 1989, and except for telephones made available to an employee with a hearing disability under Section 68.112(b)(3)(A)) in workplace establishments of fifteen or more employees must be hearing aid compatible. There shall be a rebuttable presumption that, as of January 1, 2000, all such telephones located in the workplace are hearing aid compatible.

As of January 1, 2001, where a hotel or motel uses telephones purchased during the period January 1, 1985 through December 31, 1989, the telephones in one hundred percent of hotel and motel guest rooms must be hearing aid compatible, if the hotel or motel has eighty or more guest rooms.

As of January 1, 2004, where a hotel or motel uses telephones purchased during the period January 1, 1985 through December 31, 1989, the telephones in one hundred percent of hotel and motel guest rooms must be hearing aid compatible, if the hotel or motel has fewer than eighty guest rooms.

As of January 1, 2005, non-common area telephones (except headsets, and except for telephones made available to an employee with a hearing disability under Section 68.112(b)(3)(A)) purchased between January 1, 1985 and January 1, 1989 in workplace establishments of fifteen or more employees must be hearing aid compatible. There shall be a rebuttable presumption that, as of January 1, 2005, all such telephones located in the workplace are hearing aid compatible.

j. Report to Congress: The Secretary shall send a copy of this Final Regulatory Flexibility Analysis along with this Report and Order in a report to Congress pursuant to Section 251 of the Small Business Regulatory Enforcement Fairness Act of 1996, codified at 5 U.S.C. Section 801(a)(1)(A). A copy of this RFA will also be published in the Federal Register.

APPENDIX C: FINAL RULES

Part 64 of Title 47 of the Code of Federal Regulations is amended as follows:

PART 64 - MISCELLANEOUS RULES RELATING TO COMMON CARRIERS

1. The authority citation for Part 64 continues to read as follows:

AUTHORITY: Sec. 4, 48 Stat. 1066, as amended; 47 U.S.C. 154, unless otherwise noted. Interpret or apply secs. 201, 218, 226, 228, 48 Stat. 1070, as amended, 1077; 47 U.S.C. §§ 201, 218, 226, 228, 610 unless otherwise noted.

2. Section 64.607 is amended to read as follows:

§ 64.607 Provision of hearing aid compatible telephones by exchange carriers

In the absence of alternative suppliers in an exchange area, an exchange carrier must provide a hearing aid compatible telephone, as defined in § 68.316, and provide related installation and maintenance services for such telephones on a detariffed basis to any customer with a hearing disability who requests such equipment or services.

Part 68 of Title 47 of the Code of Federal Regulations is amended as follows:

PART 68 - CONNECTION OF TERMINAL EQUIPMENT TO THE TELEPHONE NETWORK

1. The authority citation for Part 68 continues to read as follows:

AUTHORITY: Secs. 1, 4, 5, 201-5, 208, 215, 218, 226, 227, 303, 313, 314, 403, 404, 410, 602 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 151, 154, 155, 201-5, 208, 215, 218, 226, 227, 303, 313, 314, 403, 404, 410, 602, 610.

2. Section 68.3 is amended by adding the following definition to the terms used in Part 68:

* * * * *

Hearing aid compatible: Except as used at §§ 68.4(a)(3) and 68.414 of these rules, the terms hearing aid compatible or hearing aid compatibility are used as defined in § 68.316, unless it is specifically stated that hearing aid compatibility volume control, as defined in § 68.317, is intended or is included in the definition.

3. Section 68.4 is amended to read as follows:

§ 68.4 Hearing aid compatible telephones.

(a)(1) Except for telephones used with public mobile services, telephones used with private radio services, and cordless and secure telephones, every telephone manufactured in the United States (other than for export) or imported for use in the United States after August 16, 1989, must be hearing aid compatible, as defined in § 68.316. Every cordless telephone manufactured in the United States (other than for export) or imported into the United States after August 16, 1991, must be hearing aid compatible, as defined in § 68.316.

(2) Unless otherwise stated and except for telephones used with public mobile services, telephones used with private radio services and secure telephones, every telephone listed in § 68.112 must be hearing aid compatible, as defined in § 68.316.

* * * * *

4. A new Section 68.6 is added as follows:

§ 68.6 Telephones with volume control.

As of November 1, 1998, all telephones, including cordless telephones, as defined in Section 15.3(j) of these rules, manufactured in the United States (other than for export) or imported for use in the United States, must have volume control in accordance with Section 68.317 of these rules. Secure telephones, as defined by Section 68.3 of these rules, are exempt from this section, as are telephones used with public mobile services or private radio services.

5. Section 68.112 is amended by revising paragraphs (b)(1), (b)(3), (b)(4) and (b)(5), and by revising paragraph (c), to read as Sections (b)(3), (b)(5) and (b)(6), respectively, as follows:

§ 68.112 Hearing Aid Compatibility

* * * * *

(b) *Emergency use telephones.* Telephones "provided for emergency use" include the following:

(1) Telephones, except headsets, in places where a person with a hearing disability might be isolated in an emergency, including, but not limited to, elevators, highways, and tunnels for automobile, railway or subway, and workplace common areas. Note: Examples of workplace common areas include libraries, reception areas and similar locations where

employees are reasonably expected to congregate.

(2) * * *

(3) Telephones, except headsets, in workplace non-common areas. Note: Examples of workplace non-common areas include private enclosed offices, open area individual work stations and mail rooms. Such non-common area telephones are required to be hearing aid compatible, as defined in Section 68.316, by January 1, 2000, except for (i) those telephones located in establishments with fewer than fifteen employees; and (ii) those telephones purchased between January 1, 1985 through December 31, 1989, which are not required to be hearing aid compatible, as defined in Section 68.316, until January 1, 2005.

(A) Telephones, including headsets, made available to an employee with a hearing disability for use by that employee in his or her employment duty, shall, however, be hearing aid compatible, as defined in Section 68.316.

(B) As of January 1, 2000 or January 1, 2005, whichever date is applicable, there shall be a rebuttable presumption that all telephones located in the workplace are hearing aid compatible, as defined in Section 68.316. Any person who identifies a telephone as non-hearing aid-compatible, as defined in Section 68.316, may rebut this presumption. Such telephone must be replaced within fifteen working days with a hearing aid compatible telephone, as defined in Section 68.316, including, as of November 1, 1998, with volume control, as defined in Section 68.317.

(C) Telephones, not including headsets, except those headsets furnished under Section 68.112(b)(3)(A), that are purchased, or replaced with newly acquired telephones, must be:

(i) Hearing aid compatible, as defined in Section 68.316, after the effective date of Section 68.112(b)(3);

(ii) Including, as of November 1, 1998, with volume control, as defined in Section 68.317.

(D) When a telephone under Subsection (C) is replaced with a telephone from inventory existing before the effective date of amended Section 68.112(b)(3), any person may make a bona fide request that such telephone be hearing aid compatible, as defined in Section 68.316. If the replacement occurs as of November 1, 1998, the telephone must have volume control, as defined in Section 68.317. The telephone shall be provided within fifteen working days.

(E) During the period from the effective date of amended Section 68.112(b)(3) until the applicable date of January 1, 2000 or January 1, 2005, workplaces of fifteen or more employees also must provide and designate telephones for emergency use by employees with

hearing disabilities through one or more of the following means:

(i) By having at least one coin-operated telephone, one common area telephone or one other designated hearing aid compatible telephone within a reasonable and accessible distance for an individual searching for a telephone from any point in the workplace; or

(ii) By providing wireless telephones that meet the definition for hearing aid compatible for wireline telephones, as defined in Section 68.316, for use by employees in their employment duty outside common areas and outside the offices of employees with hearing disabilities.

* * * * *

(4) All credit card operated telephones, whether located on public property or in a semipublic location (e.g. drugstore, gas station, private club), unless a hearing aid compatible (as defined in § 68.316) coin-operated telephone providing similar services is nearby and readily available. However, regardless of coin-operated telephone availability, all credit card operated telephones must be made hearing aid-compatible, as defined in § 68.316, when replaced, or by May 1, 1991, which ever comes sooner.

* * * * *

(5) Telephones needed to signal life threatening or emergency situations in confined settings, including but not limited to, rooms in hospitals, residential health care facilities for senior citizens, and convalescent homes.

(A) A telephone that is hearing aid compatible, as defined in Section 68.316, is not required until:

(i) November 1, 1997, for establishments with fifty or more beds, unless replaced before that time; and

(ii) November 1, 1998, for all other establishments with fewer than fifty beds, unless replaced before that time.

(B) Telephones that are purchased, or replaced with newly acquired telephones, must be:

(i) Hearing aid compatible, as defined in Section 68.116, after the effective date of amended Section 68.112(b)(5);

(ii) Including, as of November 1, 1998, with volume control, as defined in Section 68.317.

(C) Unless a telephone in a confined setting is replaced pursuant to Section 68.112(b)(5)(B), a hearing aid compatible telephone shall not be required if:

(i) A telephone is both purchased and maintained by a resident for use in that resident's room in the establishment; or

(ii) The confined setting has an alternative means of signalling life-threatening or emergency situations that is available, working and monitored.

(6) Telephones in hotel and motel guest rooms, and in any other establishment open to the general public for the purpose of overnight accommodation for a fee. Such telephones are required to be hearing aid compatible, as defined in Section 68.316, except that, for establishments with eighty or more guest rooms, the telephones are not required to be hearing aid compatible, as defined in Section 68.316, until November 1, 1998; and for establishments with fewer than eighty guest rooms, the telephones are not required to be hearing aid compatible, as defined in Section 68.316, until November 1, 1999.

(A) Anytime after the effective date of amended Section 68.112(b)(6), if a hotel or motel room is renovated or newly constructed, or the telephone in a hotel or motel room is replaced or substantially, internally repaired, the telephone in that room must be:

(i) Hearing aid compatible, as defined in Section 68.316, after the effective date of amended Section 68.112(b)(6);

(ii) Including, as of November 1, 1998, with volume control, as defined in Section 68.317.

(B) The telephones in at least twenty percent of the guest rooms in a hotel or motel must be hearing aid compatible, as defined in Section 68.316, as of April 1, 1997.

(C) Notwithstanding the requirements of Section 68.112(b)(6), hotels and motels which use telephones purchased during the period January 1, 1985 through December 31, 1989 may provide telephones that are hearing aid compatible, as defined in Section 68.316, in guest rooms according to the following schedule:

(i) The telephones in at least twenty percent of the guest rooms in a hotel or motel must be hearing aid compatible, as defined in Section 68.316, as of April 1, 1997;

(ii) The telephones in at least twenty-five percent of the guest rooms in a hotel or motel must be hearing aid compatible, as defined in Section 68.316, by November

1, 1999; and

(iii) The telephones in one-hundred percent of the guest rooms in a hotel or motel must be hearing aid compatible, as defined in Section 68.316, by January 1, 2001 for establishments with eighty or more guest rooms, and by January 1, 2004 for establishments with fewer than eighty guest rooms.

* * * * *

(c) *Telephones frequently needed by the hearing impaired.* Closed circuit telephones, i.e., telephones which cannot directly access the public switched network, such as telephones located in lobbies of hotels or apartment buildings; telephones in stores which are used by patrons to order merchandise; telephones in public transportation terminals which are used to call taxis or to reserve rental automobiles, need not be hearing aid compatible, as defined in § 68.316, until replaced.

* * * * *

6. Section 68.224 is amended at subsection (a) to read as follows:

§ 68.224 Notice of non-hearing aid compatibility.

Every non-hearing aid compatible telephone offered for sale to the public on or after August 17, 1989, whether previously-registered, newly registered or refurbished, shall:

(a) Contain in a conspicuous location on the surface of its packaging a statement that the telephone is not hearing aid compatible, as is defined in §§ 68.4(a)(3) and 68.316 of these rules, or if offered for sale without a surrounding package, shall be affixed with a written statement that the telephone is not hearing aid-compatible, as defined in §§ 68.4(a)(3) and 68.316 of these rules; and

(b) * * *

* * * * *

7. Section 68.300 is amended by adding a new subsection (c) as follows:

§ 68.300 Labelling requirements.

* * * * *

(c) As of April 1, 1997, all registered telephones, including cordless telephones, as defined in Section 15.3(j) of these rules, manufactured in the United States (other than for export) or

imported for use in the United States, that are hearing aid compatible, as defined in Section 68.316, shall have the letters "HAC" permanently affixed thereto. "Permanently affixed" shall be defined as in Section 68.300(b)(5). Telephones used with public mobile services or private radio services, and secure telephones, as defined by Section 68.3 of these rules, are exempt from this requirement.

* * * * *

8. Section 68.316 is amended in its title and its introductory paragraph to read as follows:

§ 68.316 Hearing aid compatibility magnetic field intensity requirements: technical standards.

A telephone handset is hearing aid compatible for the purposes of this section of Part 68 if it complies with the following standard, published by the Telecommunications Industry Association, copyright 1983, and reproduced by permission of the Telecommunications Industry Association:

* * * * *

9. A new Section 68.317 is added as follows:

§ 68.317 Hearing aid compatibility volume control: technical standards.

(a) An analog telephone complies with the Commission's volume control requirements if the telephone is equipped with a receive volume control that provides, through the receiver in the handset or headset of the telephone, 12 dB of gain minimum and up to 18 dB of gain maximum, when measured in terms of Receive Objective Loudness Rating (ROLR), as defined in paragraph 4.1.2 of ANSI/EIA-470-A-1987 (Telephone Instruments With Loop Signaling). The 12 dB of gain minimum must be achieved without significant clipping of the test signal. The telephone also shall comply with the upper and lower limits for ROLR given in Table 4.4 of ANSI/EIA-470-A-1987 when the receive volume control is set to its normal unamplified level.

Note: Paragraph 4.1.2 of ANSI/EIA-470-A-1987 identifies several characteristics related to the receive response of a telephone. It is only the normal unamplified ROLR level and the change in ROLR as a function of the volume control setting that are relevant to the specification of volume control as required by this section.

(b) The ROLR of an analog telephone shall be determined over the frequency range from 300 to 3300 HZ for short, average, and long loop conditions represented by 0, 2.7, and 4.6 km of 26 AWG nonloaded cable, respectively. The specified length of cable will be simulated by a

complex impedance. (See Figure A.) The input level to the cable simulator shall be -10 dB with respect to 1 V open circuit from a 900 ohm source.

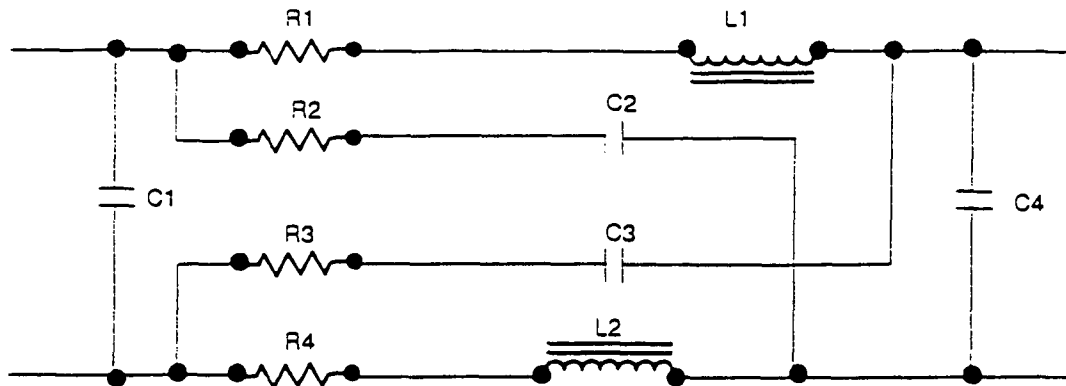
(c) A digital telephone complies with the Commission's volume control requirements if the telephone is equipped with a receive volume control that provides, through the receiver of the handset or headset of the telephone, 12 dB of gain minimum and up to 18 dB of gain maximum, when measured in terms of Receive Objective Loudness Rating (ROLR), as defined in paragraph 4.3.2 of ANSI/EIA/TIA-579-1991 (Acoustic-To-Digital and Digital-To-Acoustic Transmission Requirements for ISDN Terminals). The 12 dB of gain minimum must be achieved without significant clipping of the test signal. The telephone also shall comply with the limits on the range for ROLR given in paragraph 4.3.2.2 of ANSI/EIA/TIA-579-1991 when the receive volume control is set to its normal unamplified level.

(d) The ROLR of a digital telephone shall be determined over the frequency range from 300 to 3300 Hz using the method described in paragraph 4.3.2.1 of ANSI/EIA/TIA-579-1991. No variation in loop conditions is required for this measurement since the receive level of a digital telephone is independent of loop length.

(e) The ROLR for either an analog or digital telephone shall first be determined with the receive volume control at its normal unamplified level. The minimum volume control setting shall be used for this measurement unless the manufacturer identifies a different setting for the nominal volume level. The ROLR shall then be determined with the receive volume control at its maximum volume setting. Since ROLR is a loudness rating value expressed in dB of loss, more positive values of ROLR represent lower receive levels. Therefore, the ROLR value determined for the maximum volume control setting should be subtracted from that determined for the nominal volume control setting to determine compliance with the gain requirement.

(f) The 18 dB of receive gain may be exceeded provided that the amplified receive capability automatically resets to nominal gain when the telephone is caused to pass through a proper on-hook transition in order to minimize the likelihood of damage to individuals with normal hearing.

(g) These incorporations by reference of paragraph 4.1.2 (including Table 4.4) of American National Standards Institute (ANSI) Standard ANSI/EIA-470-A-1987 and paragraph 4.3.2 of ANSI/EIA/TIA-579-1991 were approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 C. F. R. Part 51. Copies of these publications may be purchased from the American National Standards Institute (ANSI), Sales Department, 11 West 42nd Street, 13th Floor, New York, NY 10036, (212) 642-4900. Copies also may be inspected during normal business hours at the following locations: Federal Communications Commission, 2000 M Street, N.W., Public Reference Room, Room 220, Washington, D.C. 20554; and Office of the Federal Register, 800 N. Capitol Street, N.W., suite 700, Washington, D.C.



Component	0.914 km (3 kft)	1.83 km (6 kft)
R_1, R_4	124 Ω	249 Ω
R_2, R_3	174 Ω	312 Ω
C_1, C_4	0.0113 μF	0.0226 μF
C_2, C_3	0.0122 μF	0.0255 μF
L_1, L_2	0.336 mH	0.983 mH

Notes:

(1) All values are $\pm 1\%$.

(2) 2.7 km (9 kft) and 4.6 km (15 kft) can be made up of cascaded sections of the above.

Loop Simulator for 26 AWG Cable

Figure A

APPENDIX D: STANDARDS INCORPORATED BY REFERENCE

The following standards are incorporated by reference into final rule Section 68.317 in Appendix C. These standards are in addition to the incorporation by reference into Section 68.317 of Paragraph 4.1.2 of ANSI/EIA-470-A-1987, provided in Appendix D to the Notice Of Proposed Rulemaking.

- 1) Paragraph 4.3.2 of ANSI/EIA/TIA-579-1991
- 2) IEEE Standard IEEE 661-1979
- 3) Section 7.4 of IEEE Standard IEEE 269-1991

EIA/TIA STANDARD

Acoustic-To-Digital and Digital-To-Acoustic Transmission Requirements for ISDN Terminals

EIA/TIA-579

MARCH 1991

ELECTRONIC INDUSTRIES ASSOCIATION
ENGINEERING DEPARTMENT



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This Standard does not purport to address all safety problems associated with its use or all applicable regulatory requirements. It is the responsibility of the user of this Standard to establish appropriate safety and health practices and to determine the applicability of regulatory limitations before its use.

(From Standards Proposal No. 1920-A, formulated under the cognizance of the TR-41.3 Subcommittee on Telephones.)

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**ACOUSTIC-TO-DIGITAL AND DIGITAL-TO-ACOUSTIC
TRANSMISSION REQUIREMENTS FOR ISDN
TERMINALS**

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4.2.4.2 Measurement Method

The receive S/D ratio shall be measured using the test procedure described in Section 7.7.2 of IEEE 269-1991. The digital telephone shall be placed in a quiet room with the transmitter isolated from sound input and mechanical disturbances.

Telephone sets with adjustable receive levels shall be adjusted so that their ROLR is as close as possible to the nominal value of section 4.3.2.2 for this test.

4.2.4.3 Requirement

The receive S/D ratio shall meet the following requirements:

Tone Input Level dBm0	Minimum S/D Ratio dB
-2.5 to -32.5	30
-42.5	24
-47.5	20

4.3 Objective Loudness Ratings

The rationale for the objective loudness rating requirements in this standard is contained in Appendix D.

4.3.1 Transmit Objective Loudness Rating

The TOLR for a digital telephone set is the conversion ratio of a defined acoustic signal at the mouth reference point to the transmit signal at the interface.

4.3.1.1 Measurement Method

The TOLR shall be calculated, in accordance with IEEE 661-1979 (Ref A3), from the transmit frequency response measured using Section 7.3 of IEEE 269-1991.

4.3.1.2 Requirement

The terminal should be designed to have a nominal TOLR value of -46 dB. The TOLR shall fall within the range -38 dB to -51 dB.

4.3.2 Receive Objective Loudness Rating

The ROLR for a digital telephone set is the conversion ratio of a defined digital signal at the receive input interface to an acoustic output signal from the receiver.

4.3.2.1 Measurement Method

The ROLR shall be calculated, in accordance with IEEE 661-1979, from the receive frequency response measured using Section 7.4 of IEEE 269-1991

4.3.2.2 Requirement

The terminal should be designed to have a nominal ROLR value of 51 dB. The ROLR shall fall within the range 46 dB to 56 dB. The range of ROLR values provided by terminals with adjustable receive levels may exceed these limits but should span the nominal level of 51 dB.

4.3.3 Sidetone Objective Loudness Rating

The sidetone objective loudness rating (SOLR) for a digital telephone set is the ratio of a defined input acoustic signal at the mouth reference point to the resulting acoustic output signal from the receiver.

4.3.3.1 Measurement Method

The SOLR shall be calculated, in accordance with IEEE 661-1979, from the sidetone frequency response measured using Section 7.5 of IEEE 269-1991.

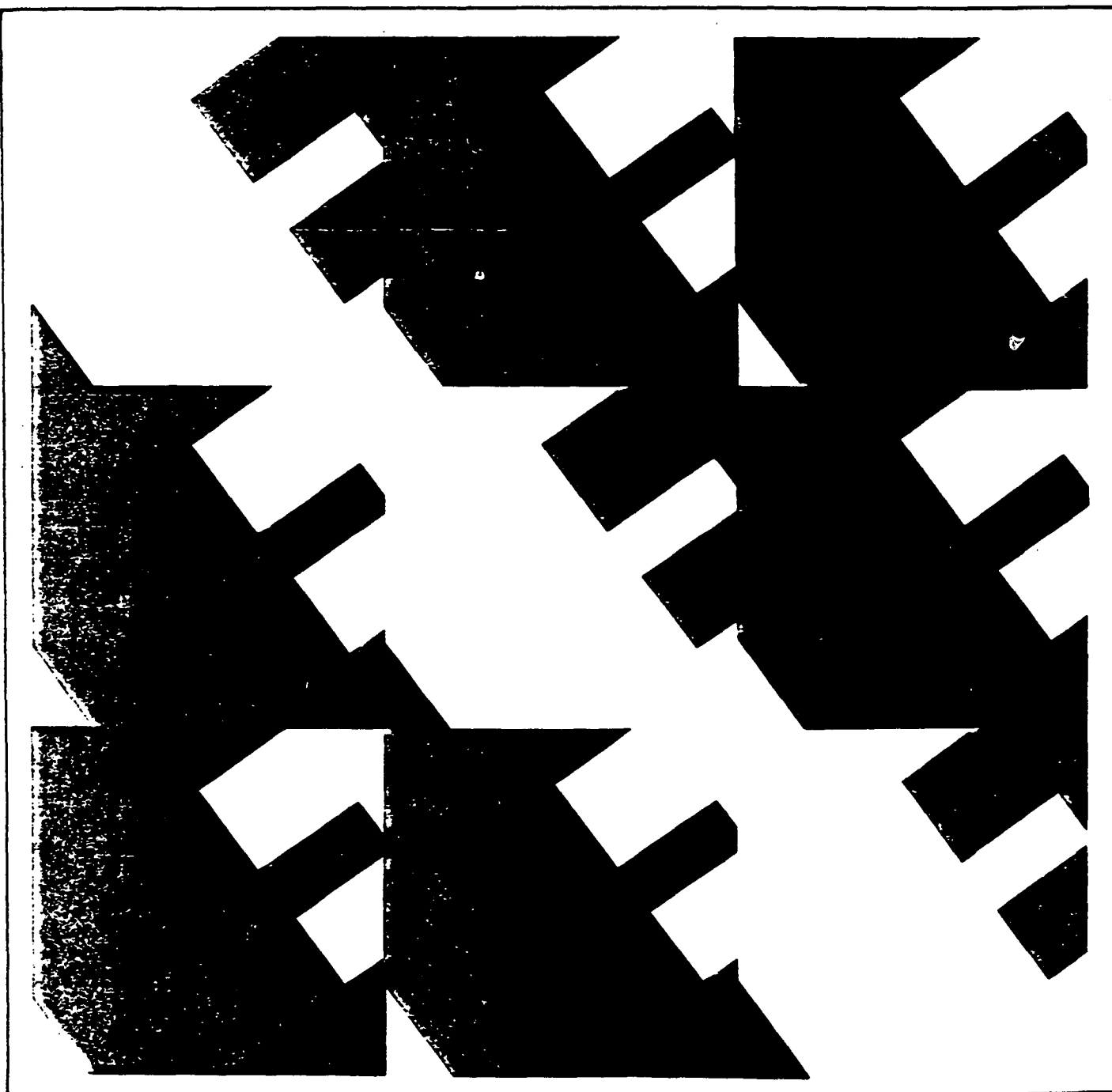
Telephone sets with adjustable receive levels shall be adjusted so that their ROLR is as close as possible to the nominal value of section 4.3.2.2 for this test.

4.3.3.2 Requirement

The SOLR shall fall within the range 3 to 15 dB.

IEEE Standard Method for Determining Objective Loudness Ratings of Telephone Connections

ANSI/IEEE Std 661-1979



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An American National Standard

IEEE Standard

**Method for Determining Objective Loudness
Ratings of Telephone Connections**

Sponsor
Transmission Systems Committee
of the
IEEE Communications Society

Approved June 16, 1978
IEEE Standards Board

Approved February 15, 1983
American National Standards Institute

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Foreword

(This Foreword is not a part of IEEE Std 661-1979, Standard Method for Determining Objective Loudness Ratings of Telephone Connections.)

This IEEE Standard Method for Determining Objective Loudness Ratings of Telephone Connections has been prepared in response to a need by the telecommunications industry for a standard method of testing transmission performance of partial and overall telephone connections in a manner that reflects the attribute of subjective loudness. This document complements and is dependent on IEEE Std 269-1971, Standard Method for Measuring Transmission Performance of Telephone Sets. Individuals from private and government design, manufacturing, and research organizations have given freely of their time in preparing, testing, and reviewing this standard.

The IEEE will maintain this document current with the state of the technology. Comments, suggestions, and requests for interpretations should be addressed to:

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IEEE Standard

Method for Determining Objective Loudness Ratings of Telephone Connections

1. Introduction

The methods that are used to measure the transmission performance of telephone connections may be divided into two classes: objective methods and subjective methods. This standard considers an objective method that can be used for measuring telephone connections in a manner that reflects the subjective attribute of loudness with an accuracy suitable for most telephone transmission engineering problems. The performance measure is expressed in terms of a defined reference and is referred to as an objective loudness rating.

The objective method utilizes a sound source to activate the telephone transmitter, and an acoustic coupler and associated microphone (artificial ear) as an acoustic termination for the telephone receiver. The sound source consists of a source of electric energy, a special type of loudspeaker unit (artificial mouth), and such supplementary electric and acoustic components as may be required so that the ensemble provides a controlled sound field.

The artificial mouth and artificial ear provide a simpler means of measuring characteristics of telephone connections than is possible with the human mouth and ear. The practical design of artificial mouths and artificial ears is such that they only approximate their respective human counterparts. Thus telephone connection characteristics measured using these devices will only approximate and not duplicate those characteristics measured with human mouths and ears. However, experience has shown that characteristics determined using these devices are highly useful in telephone transmission engineering.

Subjective methods for rating the transmission performance of telephone connections involve human talkers and listeners. Commonly

used subjective test methods include those based on loudness assessment, articulation, and judgment. [1-4].¹ The particular method employed in any given situation depends on the transmission parameter(s) to be evaluated and on the performance measure criterion of interest, for example, articulation or loudness.

Subjective methods have the particular advantage that ratings obtained are direct measures of performance. A major disadvantage of subjective methods is that they often require large groups of human subjects for long time periods in order that the results have significance. Objective methods, on the other hand, involve somewhat simpler and better controlled measurements, and a large number of measurements can be made in a relatively short period of time. Moreover, measurements can be obtained that reflect subjective evaluation with suitable accuracy.

This standard is concerned with a specific objective method of determining the loudness ratings of telephone connections. The method is based on objective measurements and computations performed in such a manner that the numerical results obtained reflect the subjective attribute of loudness.

The method was derived, employing certain simplifying assumptions, to combine simplicity and reasonably close agreement between objectively determined results and subjective responses. (See Appendix A.) Results obtained with the method described in this standard and the relation of these results to subjective test results may vary with design, for example, size and shape of the telephone handset and the type of circuitry used to control equalization

¹ Numbers in brackets refer to those of the references listed in Section 4 of this standard.

or output level, or both. Thus, specific instances might occur where the results obtained according to the method described will not be suitable for transmission engineering purposes, and supplementary subjective measurements may be required. It would, therefore, appear desirable to establish correlation between subjective measurements and objective measurements separately for each telephone set design before the measurements obtained using the method of this standard are interpreted to reflect loudness performance under conditions of actual use.

2. Scope and Purpose

2.1 The purpose of this standard is to describe a practical and reproducible method of determining the loudness ratings of telephone connections. Loudness rating may be measured directly using appropriate test instruments and facilities, as specified in this standard, or may be computed using the amplitude-frequency characteristic of the connection measured in accordance with IEEE Std 269-1971 [5].

2.2 Loudness ratings determined using this standard may not exactly duplicate subjective loudness evaluations. Moreover, measured ratings and computed ratings determined using this standard may not agree, particularly if the connection incorporates nonlinear elements. However, differences are expected to be acceptably small for engineering purposes. For example, differences for connections utilizing linear microphones are expected to be small, resulting only from instrument and measurement error, while for connections employing nonlinear microphones, for example, carbon microphones, the differences may be larger.

NOTE: For the purposes of this standard, a linear microphone is one that exhibits a one-to-one relation between input pressure and output voltage over its normal operating range.

2.3 The procedures given in this standard may be used for determining the loudness rating of partial and complete telephone connections. For complete telephone connections, comprising overall and sidetone transmission paths, the procedures involve measurement of acoustic input and output pressures.

For partial telephone connections comprising transmitting, receiving, or connection paths,

the procedures involve measurement of acoustic pressures and electric voltages.

2.4 Transmission planning of switched telephone networks is generally accomplished by working with parts of connections, for example, customer loops (telephone sets, line facilities, and feeding bridges) or trunks, to ensure that when these parts are switched together, the resulting overall connections perform satisfactorily. When planning is based on loudness, the sum of the loudness losses determined for parts of a connection should closely approximate the loudness loss of the overall connection. For such purposes the recommended analysis bandwidth is 300-3300 Hz, which approximates the bandwidth of the more band-limiting components typically found in modern telephone networks. There may be cases in which a wider bandwidth would be desirable (see Appendix A), and the methods of this standard will accommodate such wider bandwidths.

2.5 The method of this standard is based on specification of (1) characteristics of a suitable artificial mouth, (2) a standard artificial ear, and (3) appropriate auxiliary measuring instruments and facilities. The method is intended for rating connections involving telephone sets equipped with handsets. The applicability of the method for the measurement of telephone sets incorporating special devices such as noise-exclusion transmitters, distant-talking transmitters, ear insert receivers, or noise-exclusion receivers (receivers equipped with circumaural earpads) has not been reviewed. However, the loudness theory on which this standard is based is sufficiently general that advances in the art may permit measurement of many such special devices using the methods specified in this standard.

3. Definitions

NOTE: For terms not listed in this section, see Section 3 of IEEE Std 269-1971 [5], ANSI S1.1-1960 (R1976) [6], or ANSI/IEEE Std 100-1977 [7].

3.1 **Loudness Rating.** The amount of frequency-independent gain that must be inserted into a system under test so that speech sounds from the system under test and a reference system are equal in loudness.

3.2 **Reference System.** A system that provides 0 dB acoustic gain between a mouth reference

LOUDNESS RATINGS OF TELEPHONE CONNECTIONS

point at 25 mm in front of a talker's lips and an ear reference point at the entrance to the ear canal of a listener, when the listener is using an earphone. This system is assigned a loudness rating of 0 dB. The frequency characteristic of the system must be flat over the range 300-3300 Hz and show infinite attenuation outside of this range.

NOTES:

(1) If an actual reference system is constructed for subjective comparison purposes, the system response at 300 and 3300 Hz shall be down 3 ± 1 dB relative to the midband response. The gain of the system shall be adjusted to compensate for the finite slope of the filter skirts and deviation from flatness of the pass band. The amount of this adjustment can be determined by first calculating the OLR (3.3) over a frequency range that includes at least the 50 dB down points of the real response, and next calculating the OLR of the ideal response, over the same frequency range. The difference between the OLRs is the required gain adjustment.

(2) To the extent that the artificial mouth and artificial ear replicate their average human counterparts, a virtual reference system is introduced by reason of the calibration of the test system described in Section 5.

3.3 Objective Loudness Rating (OLR). The rating of a connection or its components when measured according to this standard.

3.4 Voltage and Pressure Levels. Voltage and pressure levels (V_T , V_W , S_E , and S_M) as used in definitions of this section are measured (as described in Section 5 of this standard) or computed (as described in Section 6 of this standard).

3.5 Overall Objective Loudness Rating (OOLR)

$$\text{OOLR} = -20 \log_{10} \frac{S_E}{S_M} \quad (\text{Eq 1})$$

where

S_M = sound pressure at the mouth reference point (in pascals)

S_E = sound pressure at the ear reference point (in pascals)

3.6 Transmitting Objective Loudness Rating (TOLR)

$$\text{TOLR} = -20 \log_{10} \frac{V_T}{S_M} \quad (\text{Eq 2})$$

where

S_M = sound pressure at the mouth reference point (in pascals)

²The pascal (Pa) is a unit of pressure that is equal to 1 N/m² (newton per square meter).

V_T = output voltage of the transmitting component (in millivolts)

NOTE: Normally occurring TOLRs will be in the -30 to -55 dB range. These numbers are a result of the units chosen and have no physical significance.

3.7 Receiving Objective Loudness Rating (ROLR)

$$\text{ROLR} = -20 \log_{10} \frac{S_E}{\frac{1}{2} V_W} \quad (\text{Eq 3})$$

where

V_W = open-circuit voltage of the electric source (in millivolts)

S_E = sound pressure at the ear reference point (in pascals)

NOTE: Normally occurring ROLRs will be in the 40 to 55 dB range. These numbers are a result of the units chosen and have no physical significance.

3.8 Sidetone Objective Loudness Rating (SOLR)

$$\text{SOLR} = -20 \log_{10} \frac{S_E}{S_M} \quad (\text{Eq 4})$$

where

S_M = sound pressure at the mouth reference point (in pascals)

S_E = sound pressure at the ear reference point (in pascals)

3.9 Electrical Objective Loudness Rating (EOLR). For a network

$$\text{EOLR} = -20 \log_{10} \frac{V_T}{\frac{1}{2} V_W} \quad (\text{Eq 5})$$

where

V_W = open-circuit voltage of the electric source (in millivolts)

V_T = output voltage of the network (in millivolts)

3.10 Source/Load Impedance. For the purposes of this standard, the source/load impedance used for determining loudness ratings (see 3.6-3.9) is considered to be 900 Ω resistive. See also 5.2.11 and 5.3.3.

3.11 Loudness Equation. Loudness voltages (in millivolts) and pressures (in pascals) are determined in accordance with Eq 6.

S_E, S_M, V_W or $V_T =$

$$\left\{ \frac{\sum_{j=2}^N \left(\log_{10} \frac{f_j}{f_{j-1}} \right) \left[\frac{\left(\frac{x_j}{10^{20}} \right)^{\frac{1}{2.2}} + \left(\frac{x_{j-1}}{10^{20}} \right)^{\frac{1}{2.2}}}{2} \right]}{\log_{10} f_N / f_1} \right\}^{2.2}$$

(Eq 6)

where

f_j = specific frequencies of the N frequencies selected for analysis

x_j = the signal level (in dBPa or dBmV)³ at frequency f_j

Loudness voltages and pressures are expressed in decibel-like form using Eq 7.

S'_E, S'_M, V'_W or $V'_T = 20 \log_{10} \times$

$$\left\{ \frac{\sum_{j=2}^N \left(\log_{10} \frac{f_j}{f_{j-1}} \right) \left[\frac{\left(\frac{x_j}{10^{20}} \right)^{\frac{1}{2.2}} + \left(\frac{x_{j-1}}{10^{20}} \right)^{\frac{1}{2.2}}}{2} \right]}{\log_{10} f_N / f_1} \right\}^{2.2}$$

(Eq 7)

4. References

- [1] IEEE Std 297-1969, Recommended Practice for Speech Quality Measurements.
- [2] ANSI S3.2-1960 (R1971), American National Standard Method for Measurement of Monosyllabic Word Intelligibility.
- [3] ANSI S3.5-1969 (R1973), American National Standard Methods for the Calculation of the Articulation Index.
- [4] CCITT (International Telegraph and Telephone Consultative Committee) Recommendation P 72, Measurement of Reference Equivalents and Relative Equivalents, CCITT Green Book, vol 5, International Telecommunication Union, 1973, 2 Rue de Varembe, 1211 Geneva 20, Switzerland.

³dBPa = decibels relative to 1 pascal; dBmV = decibels relative to 1 millivolt.

[5] IEEE Std 269-1971, Standard Method for Measuring Transmission Performance of Telephone Sets.

[6] ANSI S1.1-1960 (R1976), American National Standard Acoustical Terminology (Including Mechanical Shock and Vibration).

[7] ANSI/IEEE Std 100-1977, Standard Dictionary of Electrical and Electronics Terms.

[8] ANSI S1.12-1967 (R1972), American National Standard Specifications for Laboratory Standard Microphones.

[9] ANSI S1.10-1966 (R1976), American National Standard Method for the Calibration of Microphones.

[10] ANSI S3.7-1973, American National Standard Method for Coupler Calibration of Earphones.

[11] CCITT Recommendation P 51, pt B, Artificial Ear Provisionally Recommended by the CCITT, CCITT Orange Book vol 5, International Telecommunication Union, 1977, 2 Rue de Varembe, 1211 Geneva 20, Switzerland.

[12] SULLIVAN, J. L., A Laboratory System for Measuring Loudness Loss of Telephone Connections. *Bell System Technical Journal*, vol 50, no 8, Oct 1971, pp 2663-2739.

5. Instrumental Method

5.1 General. The measuring system used in the instrumental method consists of a sending end and a receiving end (see 5.3). The test equipment required to realize the measuring system is described in 5.2.

5.2 Test Equipment. The following test equipment is required for the instrumental determination of objective loudness ratings of telephone sets:

- (1) Artificial mouth
- (2) Standard circuits
- (3) Pressure microphone
- (4) Artificial ear coupler
- (5) Sweep frequency oscillator
- (6) Indicator amplifier
- (7) Microphone amplifier
- (8) Rating attenuator
- (9) Indicator
- (10) DC voltage and current meters
- (11) Impedance-matching network

5.2.1 Artificial Mouth. See 4.2 of IEEE Std 269-1971 [5].

5.2.2 Standard Circuits. See 4.3 of IEEE Std 269-1971 [5].

5.2.3 Microphone. See ANSI S1.12-1967 [8] and S1.10-1966 [9].

The type of microphone used should be that appropriate for the artificial ear coupler (see 5.2.4). For calibration of the artificial mouth, the microphone should have a flat free-field response. This may be accomplished by inserting a compensating filter in the microphone amplifier or by using a modified microphone especially designed to have a flat, free-field response.

5.2.4 Artificial Ear Coupler. The IEC coupler is used as in 4.4 of ANSI S3.7-1973 [10]. See also Ref [11].

5.2.5 Sweep Frequency Oscillator. The oscillator has an output frequency that varies logarithmically with time, sweeping the range from 300 to 3300 Hz at a rate of between 2 and 10 sweeps per second. At any point over the sweep range, the frequency must be within $\pm 3\%$ of its nominal value. The sweep waveform may be sawtooth or triangular shaped. The output level should be constant within ± 0.25 dB over the frequency range. The total distortion should be less than 1% at any level and frequency encountered.

5.2.6 Indicator Amplifier. An amplifier is required to increase the level of the input signal to a level suitable for the indicator. The frequency response characteristic should be constant within ± 0.25 dB over the 200–5000 Hz range. The total distortion should be less than 1% over the frequency range and up to the maximum levels encountered.

The amplifier should have sufficient signal-handling capability to operate 10 dB above the maximum level applied to the indicator. See 5.2.9.

The input and output impedance characteristics should be chosen so as not to interact unfavorably with the preceding stage, the following stage, or attenuator calibration.

5.2.7 Microphone Amplifier. See 4.6 of IEEE Standard 269-1971 [5].

5.2.8 Rating Attenuator. The attenuator should be 600 Ω and purely resistive, and have steps of 10 dB ± 0.1 dB when used with a meter with a calibrated scale. When used with a meter with a single reference point, the recommended steps are 10, 1, and 0.1 dB with limits of ± 0.1 , ± 0.01 , and ± 0.01 dB, respectively. A minimum range of 60 dB is recommended.

5.2.9 Indicator. The indicator is a device that measures and displays the input signal in such a manner that the reading is proportional to the loudness rating. The indicator consists of:

- (1) A rectifier
- (2) A compressor
- (3) A meter

The indicator should have the performance characteristics given in 5.2.9.1 through 5.2.9.6.

5.2.9.1 The meter scale should be marked in such a manner that for every 1 dB change in steady input signal, the meter reading changes by 1 dB. Alternatively, a single point may be used as a reference on the meter scale, and all readings taken from an external attenuator.

It will be found convenient to have the 0 dB point or reference point 3–5 dB below full scale. Points below 0 dB should be marked positive; those above, negative.

5.2.9.2 The indicator response to time-varying signals shall follow the law:

$$y = kx^{0.454 \pm 0.1}_{-0.0} \quad (\text{Eq 8})$$

where y is the meter reading, x is the input signal, and k is a constant. This is equivalent to a 2.2 to 1 dB compression ratio. Thus, a 10 dB change in input signal level produces a 4.54 dB change in the input to the meter coil, but, as specified in 5.2.9.1, appears on the meter scale as a 10 dB change.

NOTE: Commercial devices with exponent 0.5 that fall within this tolerance range are available.

5.2.9.3 The rectifier should be of the true rms type with a crest factor not less than 3:1. The time constant should be short relative to the sweep time, while the meter time constant should be long relative to the sweep time in order to average the signal over the sweep. See 5.2.9.4.

5.2.9.4 The indicator meter damping shall meet the following requirements:

Oscillator Sweeps per second	Meter Rise or Fall Time (seconds, minimum)
2	5
6	2
10	1

The rise and fall times are defined as the time it takes the meter pointer to move from a steady state at 20 dB below full scale to within 0.5 dB of full scale and from full scale to within 0.5 dB of 20 dB below full scale, when a steady-state signal that will give this deflection is applied.

The rise and fall times are measured by having two steady-state signals available, one resulting in full-scale deflection, the other 20 dB below full scale. The transition time from one state to within 0.5 dB of the other state is the fall or rise time.

For system calibration (5.4), it may be found convenient to use a shorter time constant.

5.2.9.5 The indicator deflection should be independent of frequency over the 200–5000 Hz range and should have an accuracy of ± 0.5 dB over the calibrated range of the indicator.

5.2.9.6 The attenuator (5.2.8) and amplifier (5.2.6) provide signals of optimum level to the compressor and meter.

5.2.10 *DC Voltage and Current Meters.* See 4.12 and 4.13 of IEEE Std 269-1971 [5].

5.2.11 *Impedance-Matching Network.* An impedance-matching network with an attenuation of 6 dB is inserted in the receiving end to provide impedance match between the 900 Ω resistive source/load impedance and the 600 Ω rating attenuator. For this case (see Fig 1), $R_1 \approx 520.1 \Omega$, $R_2 \approx 18.8 \Omega$, and $R_3 \approx 983.9 \Omega$.

For any other source/load impedance (see 5.3.3), the network may be designed as shown in Fig. 1. For this network:

$$R_3 = \frac{2\sqrt{3.98Z_1Z_2}}{3.98-1} \quad (\text{Eq 9a})$$

$$R_2 = Z_2 \frac{3.98+1}{3.98-1} - R_3 \quad (\text{Eq 9b})$$

$$R_1 = Z_1 \frac{3.98+1}{3.98-1} - R_3 \quad (\text{Eq 9c})$$

where

Z_1 = the system impedance

Z_2 = 600 Ω

An impedance-matching network may be required to provide impedance match between the microphone amplifier output impedance

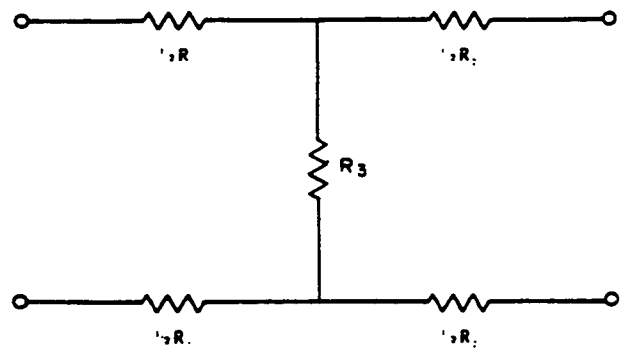


Fig 1
H-Pad Circuit

and the 600 Ω rating attenuator. The procedure outlined in this subsection may be used in the design of this network if required.

5.3 *Measuring System.* The measuring system can conveniently be divided into the sending end (Fig 2) and the receiving end (Fig 3), with the telephone connection under test inserted between them. The sending end provides electric or acoustic signals to the connection under test, and the receiving end measures acoustic or electric outputs from the connection under test.

5.3.1 *The Sending End.* The sending end consists of a sweep frequency oscillator coupled either to an artificial mouth to provide an acoustic source or to an impedance to provide an electric source. The output impedance of the electric source shall be purely resistive, 900 $\Omega \pm 1\%$. The output shall be independent of frequency within ± 0.25 dB over the 200–5000 Hz range. (See Appendix B.)

5.3.2 *The Receiving End*

5.3.2.1 The receiving end consists of an acoustic and an electric subsection coupled to the indicator.

5.3.2.2 The acoustic subsection consists of an artificial ear coupler, a microphone, a microphone amplifier, and an impedance-matching network.

5.3.2.3 The electric subsection consists of an impedance-matching network with an insertion loss of 6 dB.

5.3.3 *Source/Load Impedance Other Than 900 Ω .* The definitions (Section 3) and measuring system (5.3.1 and 5.3.2) apply for a 900 Ω resistive source/load impedance. For any other impedance the following apply:

For a source/load impedance of Z , V_{WZ} should be set equal to $V_{W900} \cdot \sqrt{Z/900}$. The rating equations then become:

$$\text{OOLR} = -20 \log_{10} \frac{S_E}{S_M} \quad (\text{Eq 10a})$$

$$\text{TOLR} = -20 \log_{10} \frac{V_T \cdot \sqrt{\frac{900}{Z}}}{S_M} \quad (\text{Eq 10b})$$

$$\text{ROLR} = -20 \log_{10} \frac{S_E}{\frac{1}{2} V_W \cdot \sqrt{\frac{900}{Z}}} \quad (\text{Eq 10c})$$

$$\text{SOLR} = -20 \log_{10} \frac{S_E}{S_M} \quad (\text{Eq 10d})$$

$$\text{EOLR} = -20 \log_{10} \frac{V_T}{\frac{1}{2} V_W} \quad (\text{Eq 10e})$$

The output and load impedances of the test equipment should be adjusted to the proper values and the matching network in the receiving end should be changed, but the 6 dB loss maintained (see 5.2.11). The above procedure maintains the same numerical values for loudness ratings at different impedances, as can be shown by insertion of ideal transformers.

Fig 2
Sending End of Measuring System

(See 3.10 and 5.2.11.)

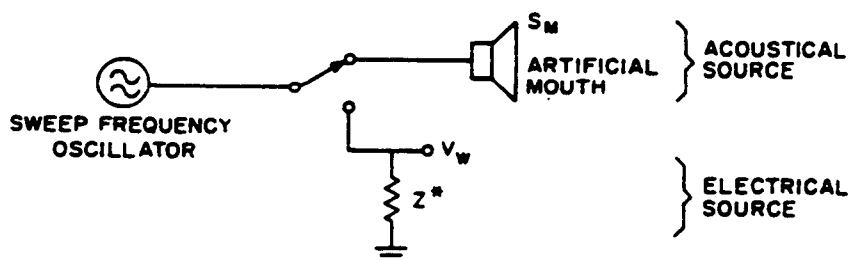
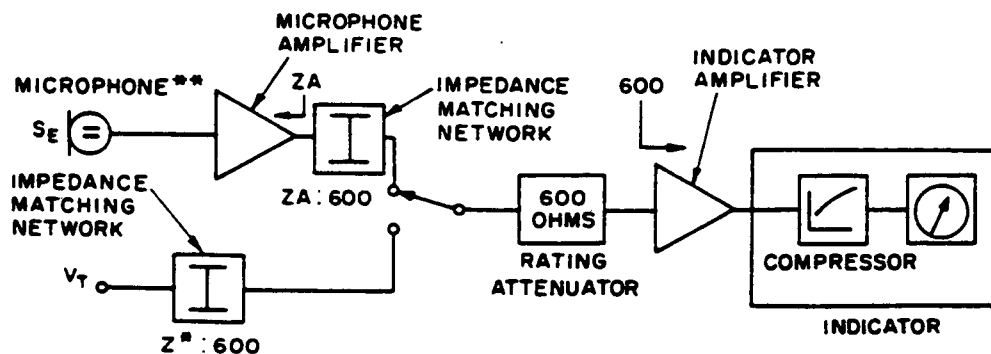


Fig 3
Receiving End of Measuring System

*See 3.10 and 5.2.11.

**For measurement of S_E (see 3.5, 3.7, and 3.8), the microphone is inserted into the artificial ear coupler.



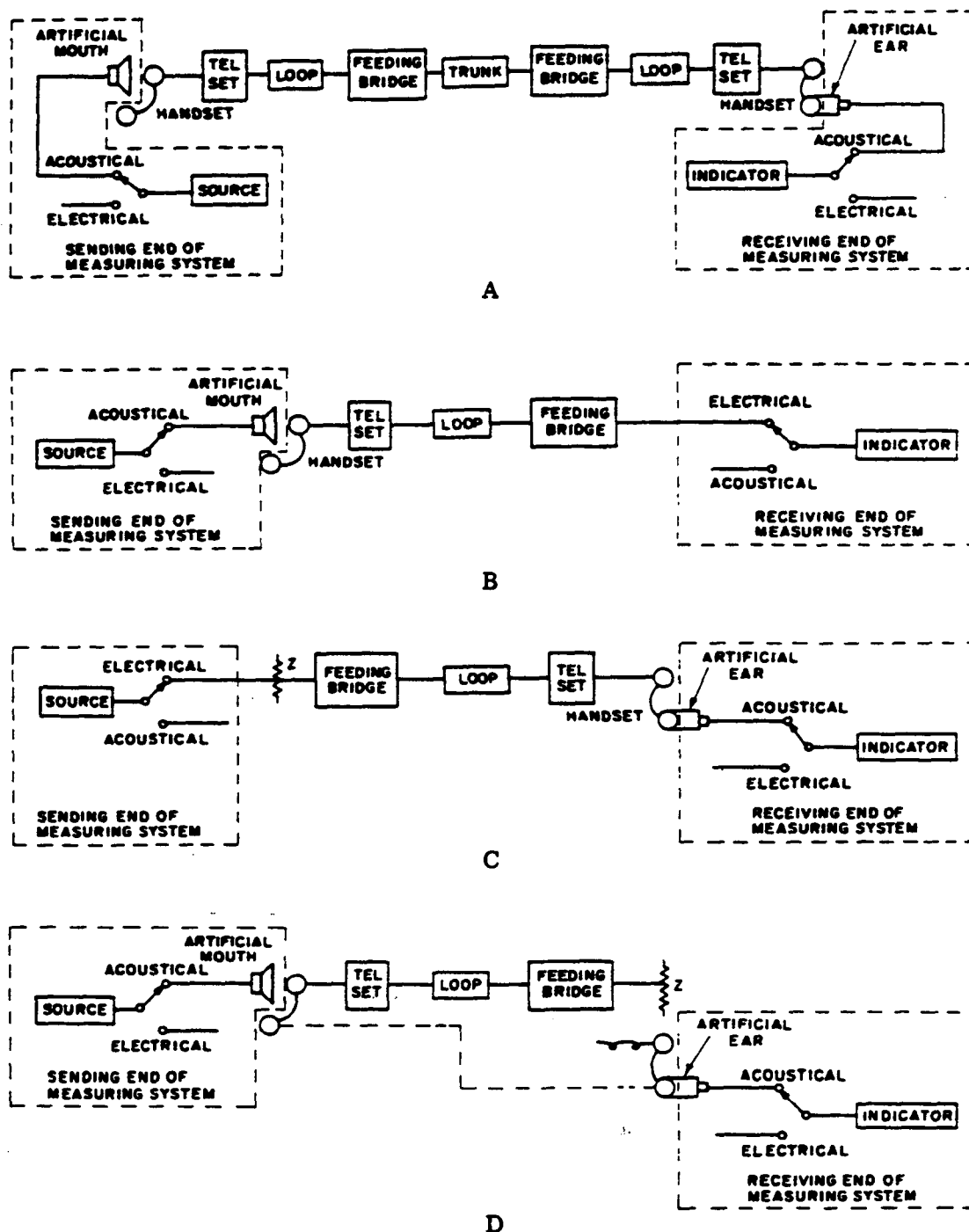
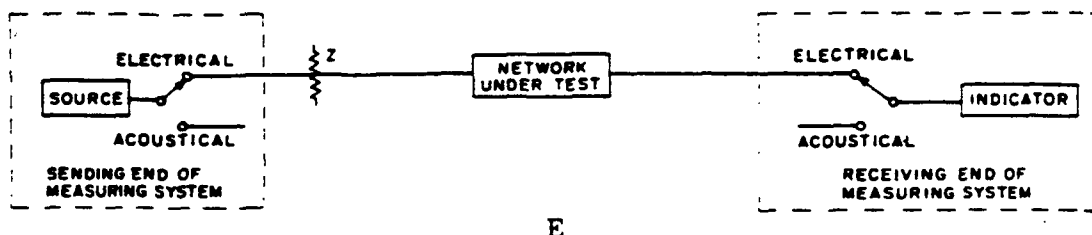


Fig 4
Test Circuits

A — Measurement of Overall Objective Loudness Rating (OOLR); B — Measurement of Transmitting Objective Loudness Rating (TOLR); C — Measurement of Receiving Objective Loudness Rating (ROLR); D — Measurement of Sidetone Objective Loudness Rating (SOLR);



E

Fig 4 — (Continued)
E — Measurement of Electrical Objective Loudness Rating (EOLR)

5.4 Calibration

5.4.1 Sending-End Calibration

5.4.1.1 Acoustic Source. Switch the oscillator to artificial mouth and start the oscillator sweep. Adjust the input to the artificial mouth for the desired pressure level, measured in accordance with 4.2 of IEEE Std 269-1971 [5]. For purposes of the present standard, the calibration position is a point on the center axis 25 ± 1 mm beyond the reference plane (lip ring). The preferred pressure level is -6 dBPa (0.5 Pa).

5.4.1.2 Electric Source. Switch the oscillator to the electric source and start the oscillator sweep. Set the open-circuit voltage to the desired value, using a voltmeter in accordance with 4.2.3 of IEEE Std 269-1971 [5]. (See note after 5.4.2.2 of the present standard.)

5.4.2 Receiving-End Calibration

5.4.2.1 Electric Subsection. Switch the receiving end for an electric input and set the rating attenuator to 40 dB. With the input connected to the electric output of the sending end, which has been set to the desired value (see note after 5.4.2.2 of the present standard), adjust the gain of the indicator amplifier for 0 reading on the meter.

5.4.2.2 Acoustic Subsection. Switch the receiving end for an acoustic input. With the rating attenuator set at 40 dB, adjust the microphone amplifier gain so that the indicator meter reads 0 (or reference point) for an acoustic input to the artificial ear microphone identical to that to which the artificial mouth was adjusted in 5.4.1.1 (-6 dBPa).

NOTE: Practical transmitting objective loudness ratings are in the vicinity of -50 dB; practical receiving objective loudness ratings are in the vicinity of $+50$ dB. It is

therefore most convenient to calibrate the electric sending and receiving ends to that 0 dB on the meter (with 40 dB setting of the rating attenuator) is -50 dB OLR for transmitting and $+50$ dB OLR for receiving. This can be done by adjusting the electric output of the sending end to 316 mV open circuit and connecting this output to the electric input of the receiving end. The amplifier gain of the indicator is then adjusted for 0 dB reading.

The 0 dB point for *transmitting* is

$$\text{TOLR} = -20 \log_{10} \frac{316/2}{0.5} = -50 \text{ dB.} \quad (\text{Eq 11a})$$

The 0 dB point for *receiving* is

$$\text{ROLR} = -20 \log_{10} \frac{0.5}{316/2} = +50 \text{ dB.} \quad (\text{Eq 11b})$$

The 0 dB point for *sidetone* is

$$\text{SOLR} = -20 \log_{10} \frac{0.5}{0.5} = 0 \text{ dB.} \quad (\text{Eq 11c})$$

The 0 dB point for *overall* is

$$\text{OOLR} = -20 \log_{10} \frac{0.5}{0.5} = 0 \text{ dB.} \quad (\text{Eq 11d})$$

5.5 Test Procedure

5.5.1 Electroacoustic Measurements. Insert the telephone set and loop to be measured in the appropriate circuit in accordance with Fig. 4. Place the handset on the artificial mouth fixture as outlined in IEEE Std 269-1971 [5].

NOTE: The position resulting from following steps 1-4 of the "standard test position" procedure (5.2.1 of IEEE Std 269-1971 [5]) is with the plane of the transmitter cap vertical. Limited tests indicate that for at least one type of telephone set equipped with a carbon transmitter, transmitting responses obtained with the plane of the transmitter cap of a handset in a position 45° to vertical, face up, more closely approximate the real voice response than do transmitting responses with the plane of the transmitter cap vertical. Therefore,

pending availability of additional information, the 45° face-up orientation is provisionally recommended as preferred. This orientation can be accomplished by following step 5 of the procedure and by altering the artificial mouth axis from horizontal as may be required.

If a carbon microphone is used, condition as outlined in 5.2.2 of IEEE Std 269-1971 [5]. Apply the appropriate input and adjust the rating attenuator for a convenient meter reading (or to the reference point). The indicator reading is the sum of the meter reading and (40 minus the attenuator reading).

Example 1:

If the attenuator is set at 30 and the meter reads +4, then the reading is +4 +(40-30) = 14 dB.

Example 2:

If the attenuator is set at 50 and the meter reads +4, then the reading is +4 +(40-50) = 6 dB.

TOLR (or ROLR) is obtained by summing the indicator reading (see Examples 1 and 2) and the calibration factors -50 dB (or +50 dB) of Eqs (11a) and (11b). OOLR (or SOLR) is numerically equal to the indicator reading.

5.5.2 Electric Measurements. Insert the circuit (loop, etc) to be measured between the electric source and the electric input to the receiving end in accordance with Fig 4 E. The EOLR is the sum of the meter reading and (40 minus the attenuator reading).

6. Computational Method

Loudness ratings can be determined from amplitude-frequency characteristics, measured in accordance with Ref [5], using the computational method. (See 5.4.1.1 for calibration position and preferred pressure level.) This method is in accordance with a loudness equation (see 3.11) and the rating definitions of 3.5 through 3.9.

The loudness ratings can be calculated using the loudness equation programmed on a computer. For a given connection, the amplitude responses at the frequencies of interest, obtained, for example, from the amplitude-frequency characteristic, need to be provided.

Alternatively, the form of Fig 5, based on the same principles, may be used. This involves plotting the amplitude-frequency characteristic on the form, determining the area under the

curve, and finding the average ordinate on the dB scale.

For transmitting components, the quantities of interest are input pressures from the artificial mouth and output voltages from the transmitting component at the frequencies of interest.

The transmitting objective loudness rating is then, in accordance with 3.6 and 3.11:

$$\text{TOLR} = -20 \log_{10} \frac{V_T}{S_M} = -V'_T + S'_M \quad (\text{Eq 12})$$

where

V_T = loudness voltage (in millivolts)

S_M = loudness pressure (in pascals)

The computation in accordance with the loudness equation of 3.11 or the form of Fig 5 provides these quantities in decibel-like terms, for example, V'_T (in dBmV) and S'_M (in dBPa), in turn computed from the output voltage and the input pressure frequency characteristics. An example is given in Table 1.

For receiving, the quantities of interest are the output pressures and input voltages as functions of frequency over the band of interest. The input voltage should, in theory, have the frequency weighting that a receive component expects to see when it is part of an overall connection (see Appendix C). However, sufficient accuracy for most engineering applications will be obtained using no weighting; that is, the input voltage level is independent of frequency.

The receiving objective loudness rating is then, in accordance with 3.7 and 3.11:

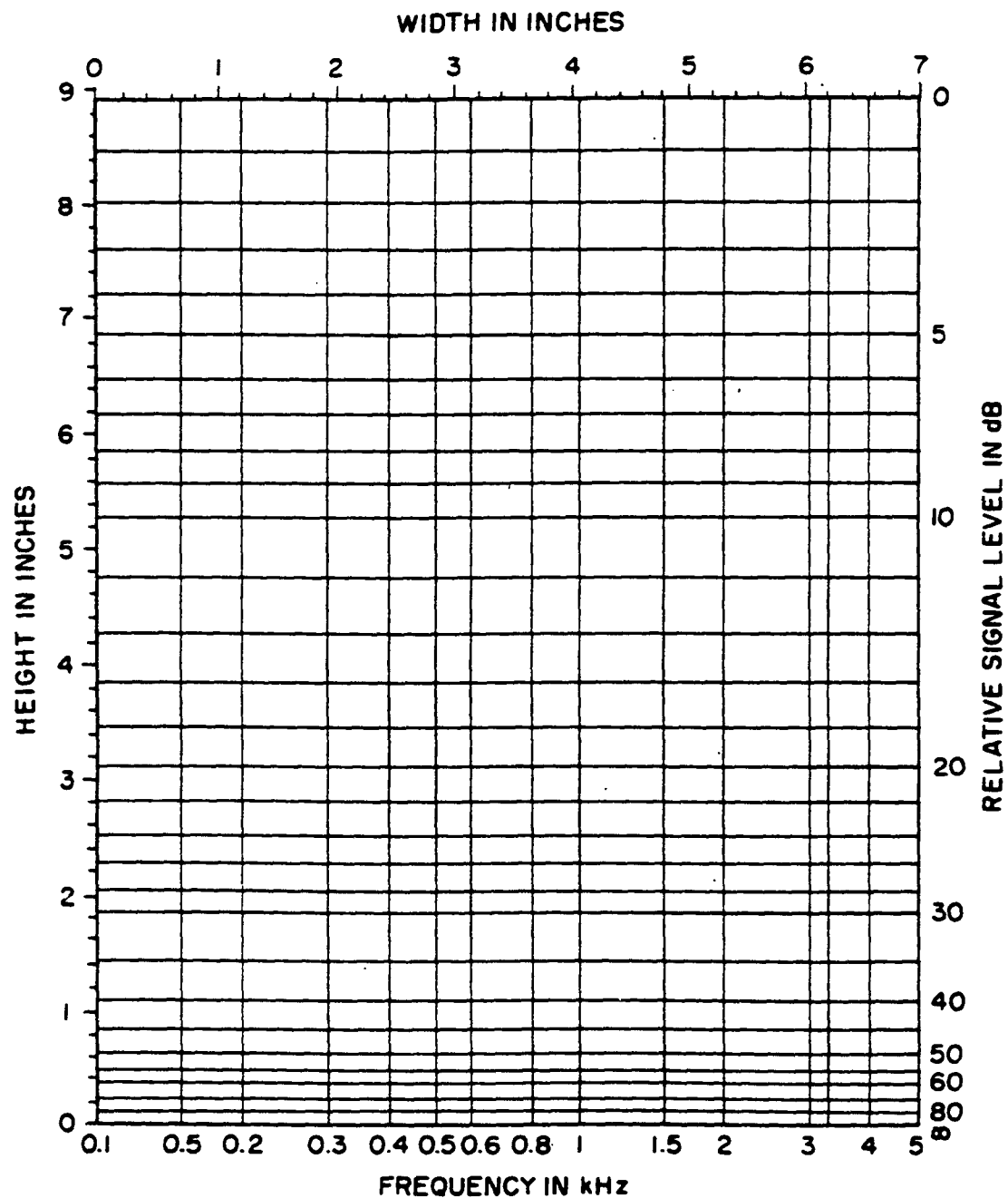
$$\text{ROLR} = -20 \log_{10} \frac{S_E}{\frac{1}{2} V_W} = S'_E + (V'_W - 6)$$

where

S_E = loudness pressure (in pascals)

$\frac{1}{2} V_W$ = one-half the open-circuit loudness voltage from a 900 Ω source (in millivolts)

The computation provides these quantities in decibel-like terms, for example, S'_E (in dBPa) and V'_W (in dBmV), in turn computed from the output pressure and input voltage frequency



TITLE _____ CIRCUIT DESCRIPTION _____
 AREA _____ in²; BASE _____ in; HEIGHT _____ in; RATING _____ dB

NOTE: Ordinate scales, $44 \log 2X = 55 - L$; abscissa scales, $X = 4.1201 (\log F - 2)$; where $X = \text{in}$, $L = \text{dB}$, $F = \text{Hz}$.

Fig 5
Graphical Loudness Computation Form

Table 1
Example of Computation of
Transmitting Objective Loudness Rating

(1) Frequency (Hz)	Artificial Mouth Sound Field (dBPa)		Transmit Component Output Voltage (dBmV)	
	(2) Uncorrected*	(3) Corrected*	(4) Uncorrected	(5) Corrected†
300	-6	-6	30.5	30.5
400	-6.8	-6.8	32	32.8
500	-7.2	-7.2	33.5	34.7
600	-7.4	-7.4	34	35.4
700	-7.6	-7.6	34.5	36.1
1000	-6.3	-6.3	37	37.3
1500	-7.5	-7.5	38	39.5
2000	-4.9	-4.9	39	37.9
2300	-6.5	-6.6	42.7	43.3
2700	-7	-7.4	45.5	46.9
3000	-7.1	-7.8	45	46.8
3300	-6.3	-7.4	42.5	43.8
Signal level‡	-6.7	-6.8	37.4	38.2

The rating may be computed using the TOLR Eq 12 with either $V'_T = 37.4$ dBmV, $S'_M = -6.8$ dBPa (corresponding to a practical source sound field), or $V'_T = 38.2$ dBmV, $S'_M = -6$ dBPa (corresponding to the ideal case where the source sound field is independent of frequency). For the former case,

$$\text{TOLR} = [-(37.4) + (-6.8)] \text{ dB} \\ = -44.2 \text{ dB}$$

while for the latter case

$$\text{TOLR} = [-(38.2) + (-6)] \text{ dB} \\ = -44.2 \text{ dB}$$

*Entries in column (2) reflect measurements made with a typical type-M pressure microphone. These are adjusted in column (3) by the free-field microphone correction (see 5.2.3).

†Corrected, from column (4), to reflect a flat sound field of -6 dBPa at each frequency.

‡Signal level numbers were computed using loudness Eq (7).

characteristics. An example is given in Table 2. For this computation, it was assumed that $V'_W = +48$ dBmV independent of frequency.

The particular frequencies used in Tables 1 and 2 were chosen arbitrarily. Selection of spe-

Table 2
Example of Computation of
Receiving Objective Loudness Rating

Frequency	Receiving Component Output Pressure (dBPa)
300	-6.5
400	-2.0
500	-1.6
600	-2.3
700	-3.0
1000	-3.6
1500	-2.0
2000	-4.2
2300	-4.3
2700	-3.0
3000	-4.5
3300	-4.5
Signal level*	-3.1

*Signal level number computed using loudness Eq (7).

NOTES:

(1) The receiving objective loudness rating is then

$$\text{ROLR} = [-(-3.1) + (48 - 6)] = 45.1$$

(2) For sidetone paths and overall connections, the procedure is the same as for transmitting and receiving except that the quantities used for the computation are input and output pressure frequency characteristics over the band of interest. Similarly, the procedure is the same for connecting circuits except that the quantities used are input and output voltage frequency characteristics over the band of interest.

cific frequencies used in computing loudness ratings are left to the discretion of the user.

NOTE: *Guidelines.* The method of implementing loudness computations, for example, automated measurement and calculation, may indicate that for convenience, the frequencies should be evenly spaced on (1) a linear frequency scale or (2) a logarithmic frequency scale. For (1) no fewer than 31 frequencies should be used. For (2) no fewer than 12 frequencies should be used, and more than 20 frequencies would not improve accuracy significantly. When manually computing loudness ratings from frequency characteristics, an inflection point approach may be more convenient.

Appendixes

(These Appendixes are not part of IEEE Std 661-1979, Method for Determining Objective Loudness Ratings of Telephone Connections.)

Appendix A Loudness Rating Method

A particular speech loudness computation method, depicted in Fig A1, is based on performing certain operations on the speech pressure spectrum that is delivered by a telephone connection to the ear of a listener [12]. These operations consist of (1) dividing the received speech spectrum into a number of different frequency bands, (2) determining the loudness due to each band, and (3) summing across all bands to obtain the total loudness.

The receiving pressure spectrum consists of (1) the reference speech spectrum L_s applied at the transmitting end of a connection modified by (2) the amplitude transfer characteristic R of the connection.

Not all of the received spectrum contributes to loudness; that is, that portion of the spectrum lower in level than the threshold of

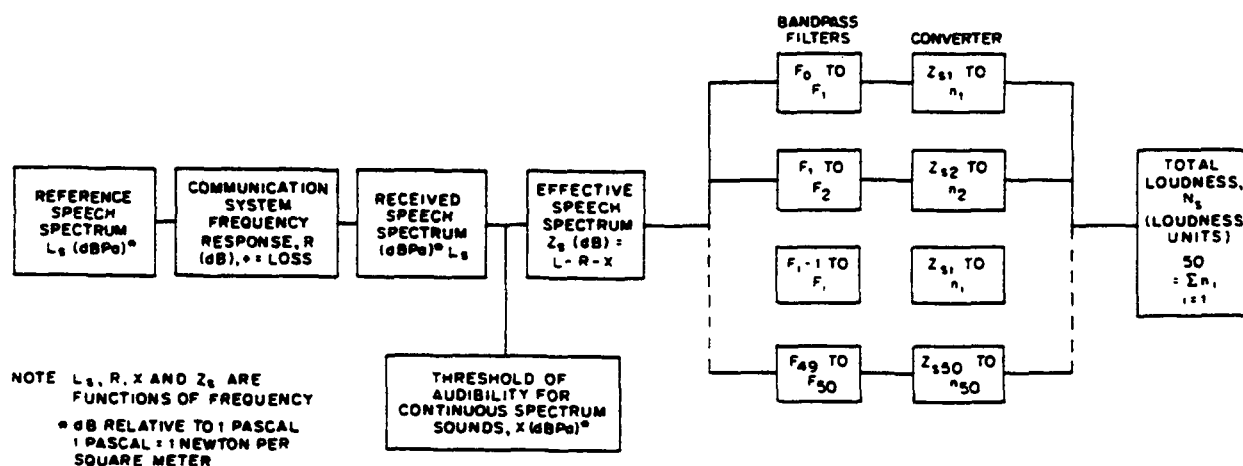
hearing does not contribute. Account is taken of this by defining a quantity termed effective spectrum Z_s which is the received spectrum minus X , which can be regarded as the threshold of audibility for continuous spectrum sounds.

The effective spectrum is divided into N frequency bands, selected such that each contributes equally to the total loudness produced by a flat effective spectrum. (For purposes of illustration, as in Fig A1, $N = 50$.) The effective level in each band is then converted to loudness units, and the loudness units summed for the N (for example, 50) bands. The resulting sum N_s represents the total loudness of the particular received spectrum.

The quantity N_s is interpreted in terms of the level of a selected reference signal having the same loudness. The selected reference signal

Fig A1
Computation of Speech Loudness

*dB relative to 1 Pa (pascal); 1 Pa = 1 N/m² (newton per square meter).
NOTE: L_s , R , X , and Z_s are functions of frequency.



may be a single frequency tone (1 kHz), white noise, etc. A more significant and meaningful reference, and one used in the speech loudness computation method, is a received speech spectrum of known properties.

The speech loudness computation method proved reasonably satisfactory for many types of engineering studies. However, review of the method suggested that certain changes and simplifying assumptions could be made, resulting in a simpler method that appeared to be suitable for most telephone engineering problems concerned with loudness. The simpler method, essentially equivalent to that depicted in Fig A1, is based on determining the level of a reference signal whose level is independent of frequency across the band of interest and whose loudness is the same as that of a test signal, which may be an input or output voltage or pressure signal.

NOTE: This concept is inherent in most, if not all, loudness rating methods. For example, loudness ratings of test systems are frequently determined in terms of the flat loss or gain (in dB) which needs to be inserted into a well-defined reference system so that the loudness of the speech heard over the test and reference systems is the same.

The principle of the simpler method referred to above is shown in the loudness equation given below and in 3.11 of the standard.

Reference signal level =

$$20 \log_{10} \left\{ \frac{N \sum_{j=2} \left(\log_{10} \frac{f_j}{f_{j-1}} \right) \left[\frac{(10^{x_j/20})^{\frac{1}{2.2}} + (10^{x_{j-1}/20})^{\frac{1}{2.2}}}{2} \right]}{\log_{10} f_N/f_1} \right\}^{2.2} \quad (\text{Eq A1})$$

where

f_j = specific frequencies of the N frequencies selected for analysis

x_j = signal level (in dBPa or dBmV) at frequency f_j

In the equation, the operation $10^{\frac{x_j}{20}}$ changes the dB level to a pressure or voltage. Then the 2.2 root of this element and of the element at the next lower frequency are determined,

summed, and the average taken. This average is then multiplied by

$$\log_{10} \frac{f_j}{f_{j-1}} [= \log_{10} f_j - \log_{10} (f_{j-1})].$$

(This operation can be considered as finding the loudness of an element of the received signal spectrum by finding the area under a curve.) The elements are summed across the analysis band and then divided by

$$\log_{10} f_N/f_1 (= \log_{10} f_N - \log_{10} f_1)$$

where

f_N = the highest frequency

f_1 = the lowest frequency

to find the average height of the curve. This average height represents the relative loudness, in dimensionless units, of the received spectrum. Taking the 2.2 power of the average and then converting to decibel-like terms by $20 \log_{10}$ operation comprises, in essence, finding the pressure magnitude (in dBPa) or voltage magnitude (in dBmV) of the reference signal that has the same loudness as the signal under consideration. (Note that the reference signal level is independent of frequency.)

The review of the speech loudness computation method referred to earlier showed that for convenience, the acoustic source signal level when determining transmitting, sidetone, and overall loudness ratings, should be independent of frequency. Thus, the reference signal level of the source signal is its rms pressure spectrum level. For any other acoustic source signal, the reference signal level is according to Eq A1. Source signals for determining receiving and connecting circuit loudness ratings should have the spectrum that is, on the average, impressed at the input of these connection components when they are part of an overall connection. (See Appendix C.)

The instrumental method (Section 4 of the standard) is based on the loudness equation. The sending and receiving ends of the measuring system together incorporate features such that their combined operation replicates the operations in the loudness equation.

The analysis bandwidth selected for the instrumental method was 300–3300 Hz. The reason for limiting the bandwidth was a prac-

tical one. The use of partial connection ratings as engineering tools implicitly requires that for any given connection, the sum of the partial ratings (for example, transmitting plus receiving) should approximately equal the overall rating. Thus, the bandwidth used to obtain these ratings should approximate the bandwidth of the most restrictive element(s) in order to avoid cumulating bandwidth penalties when summing partial ratings. The specific limits of 300 Hz

and 3300 Hz were selected largely on the basis of bandwidth capabilities of broad-band carrier systems with 4 kHz channel spacing. In some cases, for example, evaluation of a telephone sidetone path, a wider analysis band, for example, 100–5000 Hz, may permit better estimation of the loudness loss. The method described in the standard may be used in such cases.

Appendix B Weighted Acoustic Source Signal

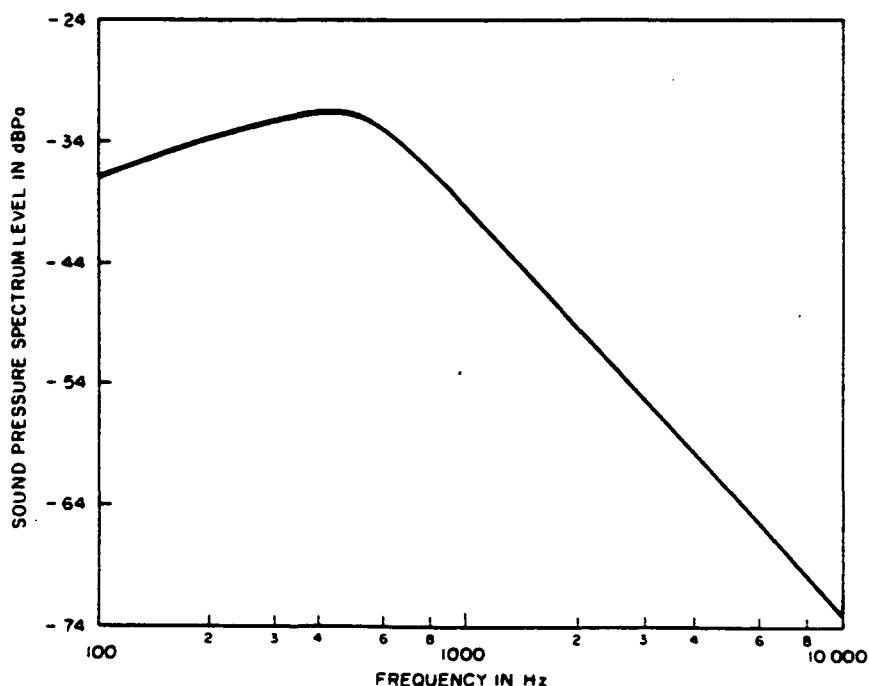
B1. General

The theoretical considerations that led to the test method specified in this standard require an acoustical output from the artificial mouth that is flat over the frequency range and changing in frequency logarithmically with time [12]. When measuring carbon microphones, it is common practice in the industry to amplitude

modulate the acoustic input signal, for instance, by the use of a speech-weighting network. If a speech-weighting network is used to shape the acoustical input to the system under test, it should be followed by an inverse speech network in the receiving end of the measuring system, so that the overall input to the indicator will be flat when the system is calibrated. A curve shape commonly used for speech weighting is shown in Fig B1.

Fig B1
Sound Pressure Spectrum of Continuous Speech at
Two Inches from the Lips of a Talker

NOTE: Averaged and smoothed from data for 13 males and 12 females.



B2. System Calibration When Speech Weighting is Used

The calculated loudness rating of the speech spectrum shown in Fig B1 over the range of 300–3300 Hz is -0.6 dB relative to the 1000 Hz level of the signal. The calculated loudness rating of the free-field response of the type-M microphone relative to the pressure response is -0.1 dB. The free-field correction at 1000 Hz is 0 dB. To calibrate proceed as follows:

(1) Calibrate the acoustic input subsection normally

(2) Place the type-M microphone from the artificial ear at the calibration point of the artificial mouth. Set the oscillator frequency to 1000 Hz and with speech weighting in, adjust the oscillator output for a reading of 0.6 dB on the indicator ($+0.6 - 0$ dB for 1000 Hz free-field correction)

(3) Start sweep and switch in the inverse speech network. Adjust the indicator amplifier gain for a reading of -0.1 dB.

Appendix C Weighted Electrical Source Signal

Reference [12] assumes that the electric input during receive tests is shaped to simulate the transmitting response of a telephone set. Experiments have shown that the effect of this shaping relative to a flat input is less than 0.5 dB in the case of a typical telephone set of modern design.

As the use of a shaped input can lead to extensive tests where several types of telephone sets are to be evaluated, each with a different transmit response, and in view of the slight difference in the results, it is recommended that a flat input be used for receive tests.



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IEEE Standard Methods for Measuring Transmission Performance of Analog and Digital Telephone Sets

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IEEE Standard Methods for Measuring Transmission Performance of Analog and Digital Telephone Sets

Sponsor
Transmission Systems Committee
of the
IEEE Communications Society

Approved June 18, 1992
IEEE Standards Board

Abstract: Practical methods for measuring the transmission characteristics of both digital and conventional two-wire analog telephone sets by means of objective measurements on a test connection are described. The test results thus obtained may be used as a means of evaluating or specifying the transmission performance of a telephone set on a standardized basis. The methods are applicable to telephone sets incorporating carbon or linear transmitters. Measurements are over the frequency range most useful for speech: 100–5000 Hz. The test methods are not intended to be applicable to special devices, such as noise-exclusion transmitters, distant-talking transmitters, insert-type receivers, or noise-exclusion receivers equipped with large ear pads.

Keywords: analog telephone sets, digital telephone sets, telephony, voice transmission performance

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For a sinusoidal signal, an open-circuit voltage of 0.316 V (-10 dB relative to 1 V) from a 900 Ω source is recommended so as to be consistent with IEEE Std 661-1979 [11]. A value of 0.251 V (-12 dB relative to 1 V) may be used so as to preserve continuity with other measurement standards.

The recommendation for a continuous spectrum signal is a level of -18 dBV open circuit across the frequency band 100 Hz to 5000 Hz.

The electric source and the measurement circuit should have the capability of operating linearly up to a level of approximately 1 V.

NOTE: Lower levels than those recommended above may be required for specific measurements, e.g., volume control and AGC. The level used should be stated.

6.4.2 Frequency Response. The receive frequency response of the telephone set is the RMS-PS of the telephone set acoustic output signal measured in the artificial ear divided by the RMS-PS of the input signal.

$$\text{Receive Frequency Response} = \frac{\text{RMS-PS of Acoustic Output}}{\text{RMS-PS of Electrical Input}} \quad (\text{Eq 7})$$

The input signal is the electrical signal developed by the generator across a 900 Ω load without the telephone connected. In practice, the input signal is obtained by measuring the RMS-PS at the generator reference point and applying a correction response. The generator reference point is an electrical terminal in the generator circuit that is unaffected by loading due to the electrical impedance of the telephone. The measured results should be reported as decibels relative to one pascal per volt (dBPa/V) with respect to the voltage across the 900 Ω calibration load (cal load) in Fig 7.

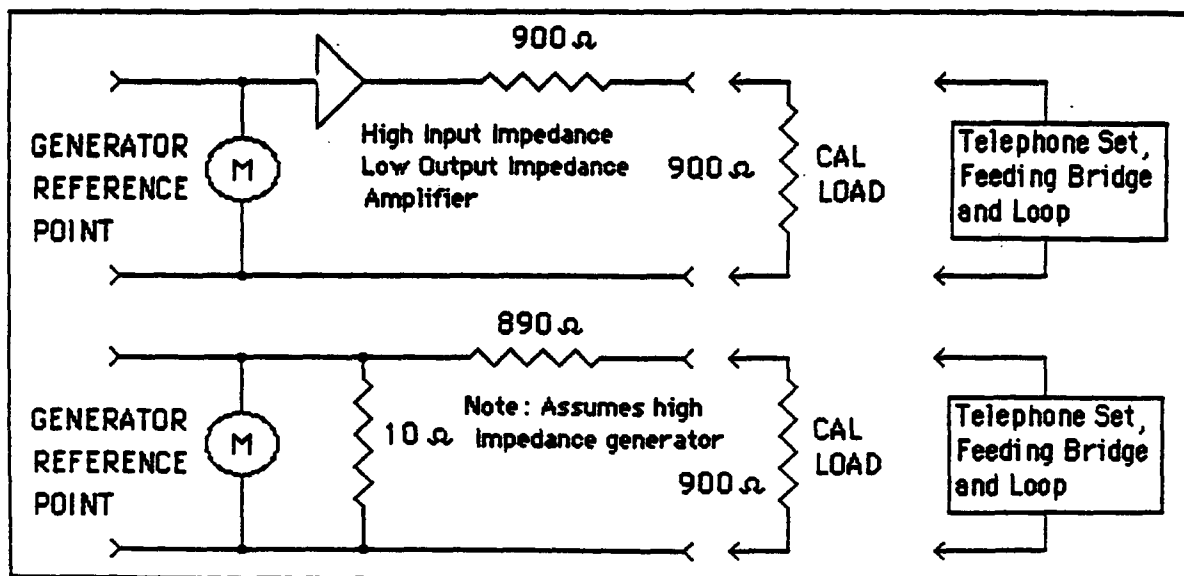


Fig 7
Receive Source Configurations

6.4.2.1 Sinusoidal Method. For the sinusoidal method, the input signal is typically held constant and the receive frequency response is defined by Eq 8.

$$\text{Receive Frequency Response} = \frac{\text{Acoustic Output in Artificial Ear}}{\text{Constant Electrical Input at 900 } \Omega \text{ Calibration Load}} \quad (\text{Eq 8})$$

6.4.2.2 Continuous Spectrum Method. For the continuous spectrum method, the receive frequency response is defined by Eq 9.

$$\text{Receive Frequency Response} = \frac{\left[\frac{\text{RMS-PS of Acoustic Output in Artificial Ear}}{\text{RMS-PS at General Reference Point}} \right] \text{Measured Response}}{\left[\frac{\text{RMS-PS at 900 } \Omega \text{ Calibration Load}}{\text{RMS-PS at General Reference Point}} \right] \text{Correction Response}} \quad (\text{Eq 9})$$

The correction response, measured without the telephone connected, is the RMS-PS developed by the generator across a 900 Ω load divided by the RMS-PS at the generator reference point. (See Fig 7.)

To determine the receive frequency response, measure the correction response and then measure the receive sound pressure level spectrum and the spectrum at the generator reference point. Apply the results to Eq 9.

In all continuous spectrum measurements, averaging time shall be sufficient to obtain the required accuracy in the spectrum estimates.

When using the preferred signal of 5.5.1, averaging time shall be at least one full period of the signal. Averaging time shall be stated.

6.4.3 Noise. Connect the telephone set to the feed circuit of Fig 1a or Fig 1c and, if desired, a loop circuit. The handset should be isolated from sound input and mechanical disturbance that would cause significant error. Measure the signal from the artificial ear using the meter specified in 5.15.2. Measurements may be made over a range of loop currents.

6.4.4 Input-Output Linearity. This measurement is comprised of steps in 6.4.2 but is made for input levels representing the total range that the telephone set is expected to encounter in use. The measurement may be made at any frequency or over any frequency band of interest. It should be noted that when the preferred signal of 5.5.1 is used, the peak-to-rms ratio is about 10 dB higher than the ratio for sinusoidal signals. For a linear characteristic, the output should follow an input level change decibel for decibel. Acoustic limiting of high-level steady-state signals is obtained when an increase in input levels results in no increase in the acoustic output.

6.4.5 Distortion. The discussion of 6.3.5 applies. Receiving distortion may be measured using the test circuits of Figs 5b or 6b and the procedures of 6.4.1 to generate the input signal.

6.4.6 Equalization. Receiving equalization should be measured using one of the circuits of Fig 5b or Fig 6b. For various line currents representing the range of currents the telephone is expected to encounter in use, the receive characteristics should be measured as in 6.4.2.

6.4.7 Peak Acoustic Pressure (Surge Input). Peak acoustic pressure can be measured by following this procedure:

- (1) Connect the line terminals of the telephone set to a battery feed circuit of Fig 1.
- (2) Connect the surge generator of Fig 8 to the battery feed (telephone side) so that terminal A is connected to the positive terminal of the battery feed.
- (3) With the ear-cap of the telephone set sealed to the artificial ear, measure the peak pressure in the artificial ear while operating the surge generator. An oscilloscope or a sound level meter, having an unweighted "peak hold" mode setting, with a time constant equal or less than 50 μ s, is used to make the measurement.
- (4) Reverse the telephone set connection and repeat step 3.

7. Test Procedures for Digital Sets

7.1 General. Use of a reference codec test methodology means that test procedures for digital telephone sets, in general, follow those for analog telephone sets. An important difference, however, concerns the test circuits. See 6.1 for general information on procedures.

7.2 Standard Circuits. The standard circuits for transmission measurements are shown in Figs 11 through 14. Fig 11 shows the general test arrangement for digital telephone sets with a digital telephone set interface and the test bed containing the reference codec. Figs 12 and 13 show measurement setups for the sinusoidal method and the continuous spectrum method.

7.3 Transmit Frequency Response. The test circuit for transmit is shown in Fig 12a or Fig 13a. The measurement procedure should be as in 6.3.2.

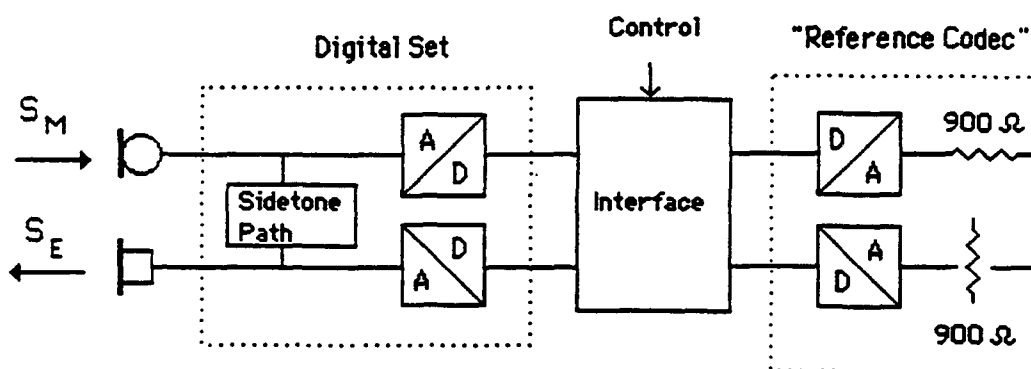


Fig 11
Digital Telephone Test Arrangement

7.4 Receive Frequency Response. The test circuit for receive is shown in Fig 12b or Fig 13b. The measurement procedure should be as in 6.4.2.

7.5 Sidetone Frequency Response. The test circuit for sidetone is shown in Fig 12c or Fig 13c. The measurement procedure should be as in 6.5.2. The reference codec is not used in the measurement but may remain in the test circuit.

7.6 Overall Frequency Response. The overall response should be measured using two telephone sets back-to-back, connected through the interfaces without the ideal codec. The test circuit for overall is shown in Fig 12d or Fig 13d. The measurement procedure should be as in 6.6.2.

7.7 Signal-to-Distortion Ratio. The handset should be isolated from sound input or mechanical disturbance that may introduce significant error.

7.7.1 Transmit. The transmit signal-to-distortion ratio is the ratio of the signal power of a pure tone to the C-message weighted distortion power at the output of the reference codec. Using Fig 12a, transmit a pure tone following the procedures in 6.3.2. The output signal is measured according to Section 4.3.2 of IEEE Std 743-1984 [12]. The pure tone typically has a frequency between 1004 Hz and 1020 Hz and an input level between 60 dB SPL and 105 dB SPL.

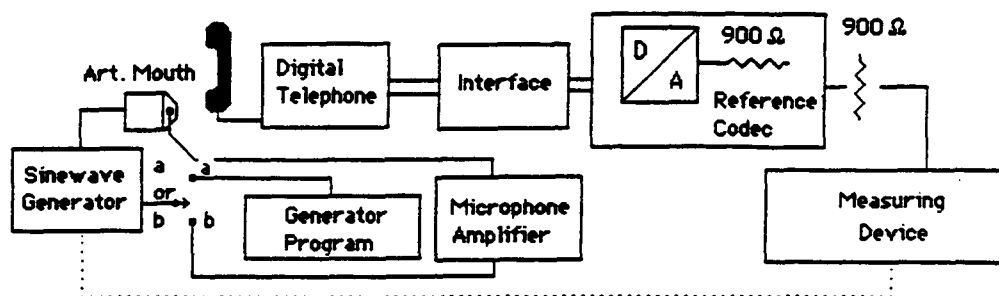


Figure 12a Transmit

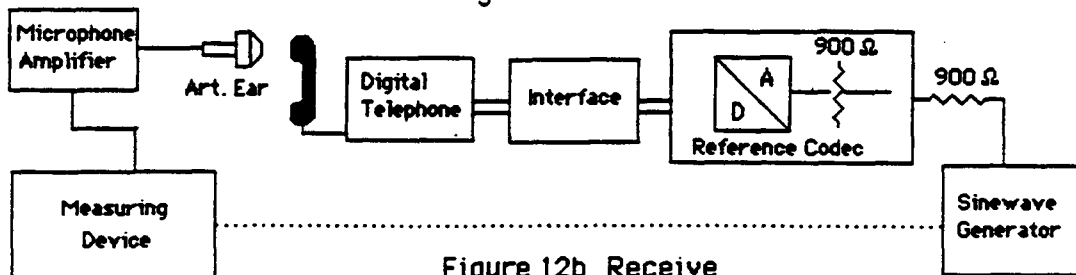


Figure 12b Receive

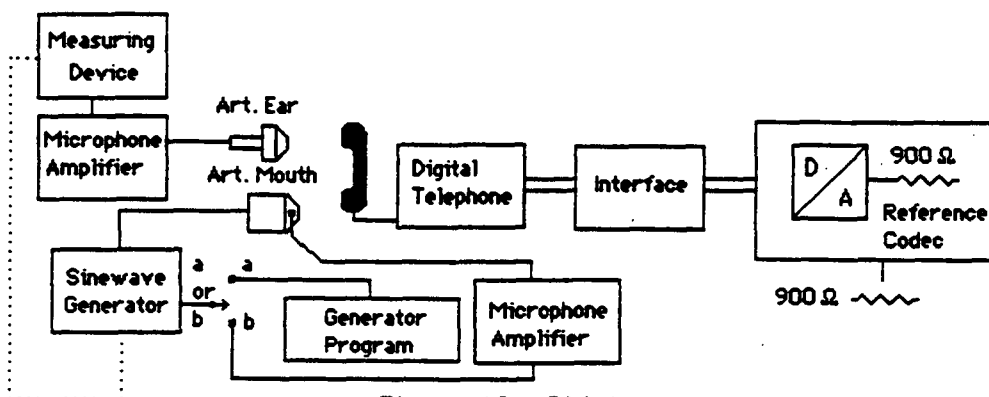


Figure 12c Sidetone

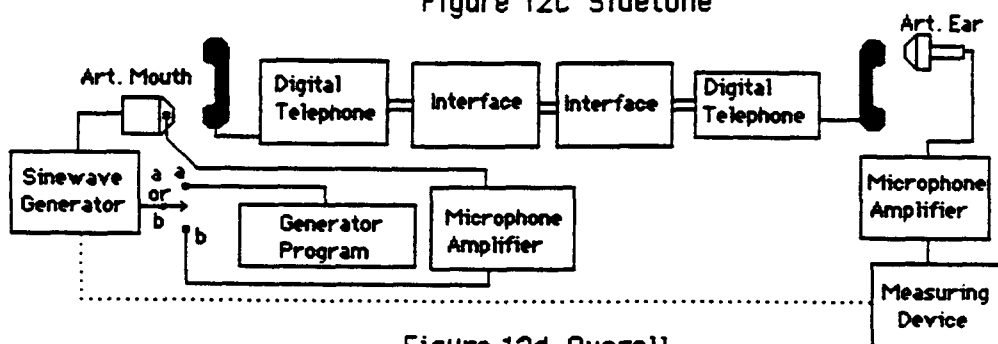


Figure 12d Overall

Fig 12
Digital Test Circuits—Sinusoidal Method

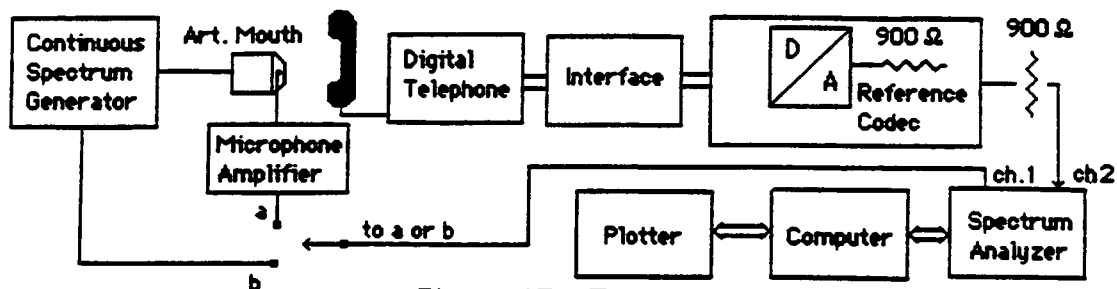


Figure 13a Transmit

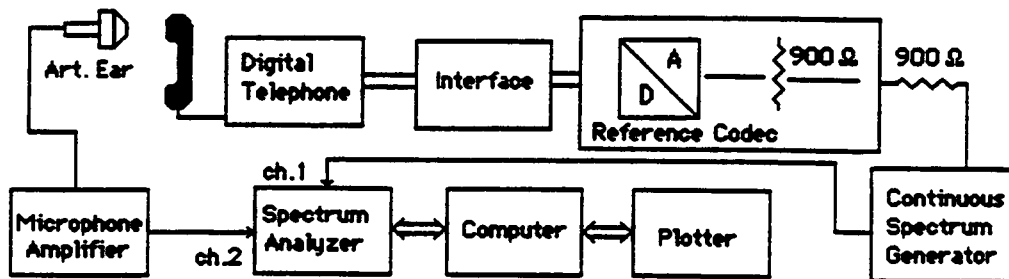


Figure 13b Receive

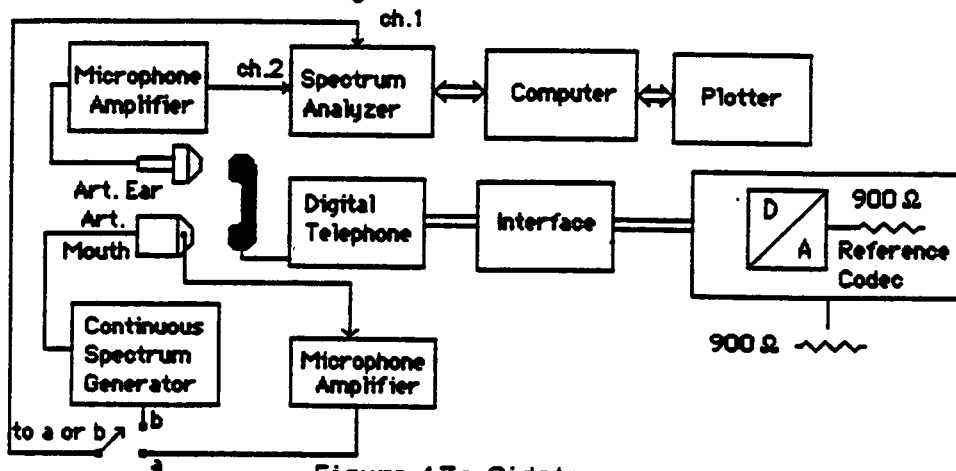


Figure 13c Sidetone

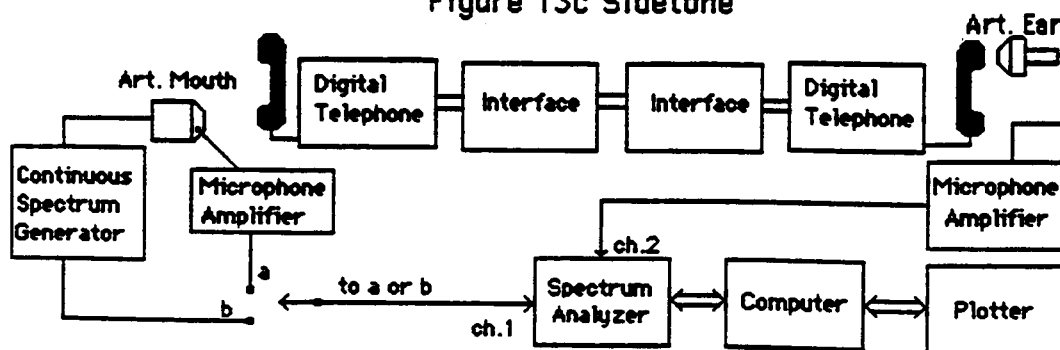


Figure 13d Overall

Fig 13
Digital Test Circuits—Continuous Spectrum Method